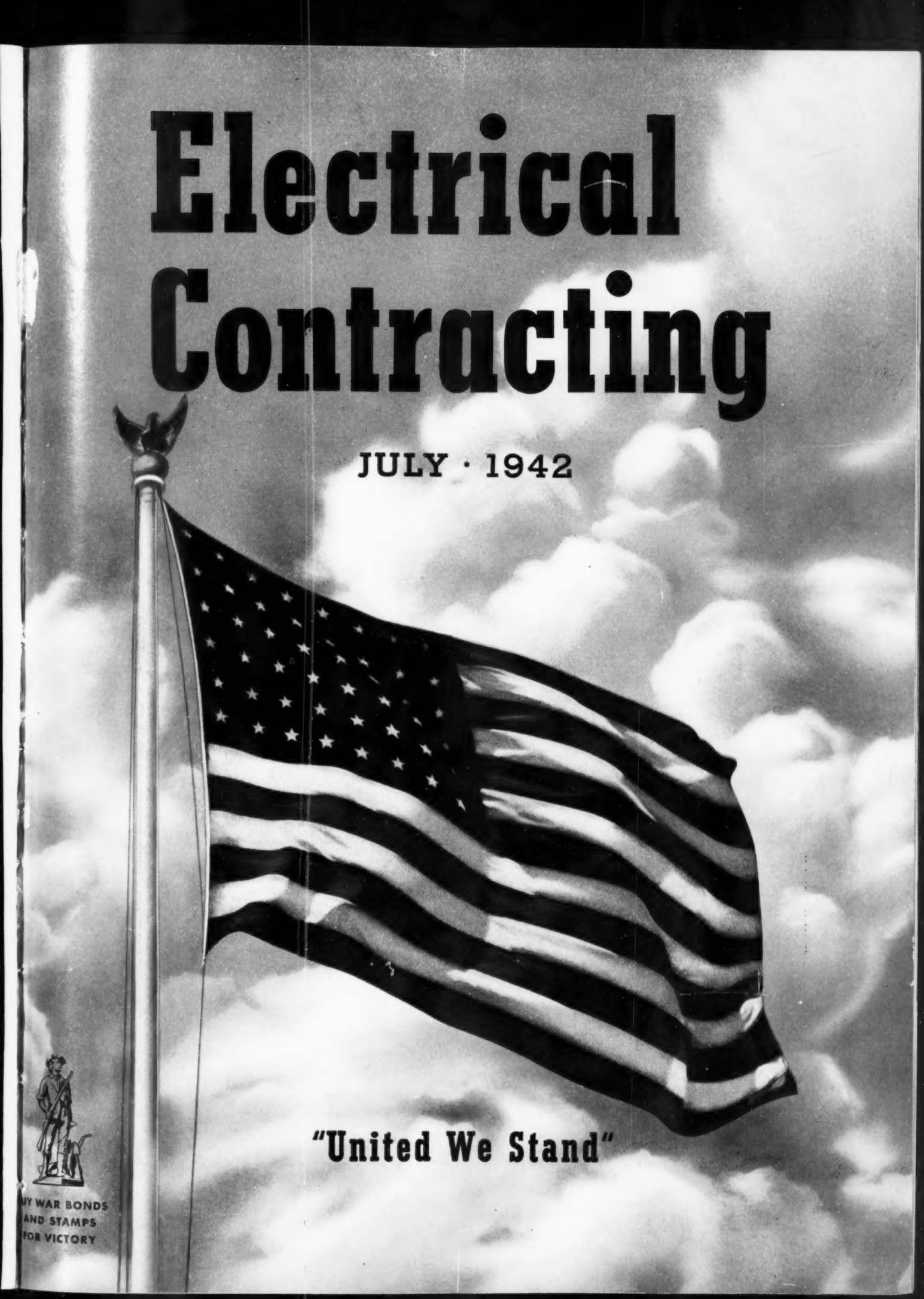
Electrical Contracting

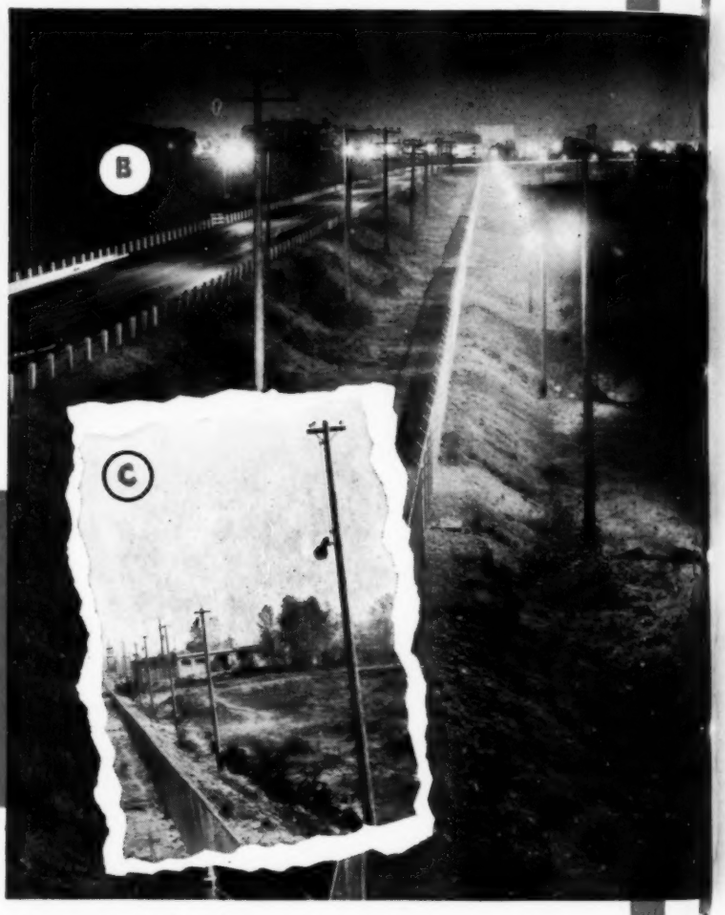
JULY · 1942



"United We Stand"

UY WAR BONDS
AND STAMPS
FOR VICTORY

What Makes THIS PROTECTIVE FENCE LIGHTING So Good?



It's Exact Control of VISIBILITY and GLARE with Form 79VR Luminaires

GOOD protective fence lighting should provide these three advantages:

- An adequate volume of light
- Sufficient overlap to prevent a dark area if one lamp in the circuit should fail
- Freedom from objectionable glare

That's exactly what you get when you use G-E Form 79VR luminaires. Two diametric beams—with more candlepower at the high angles—"reach out" farther and interfere less with visibility than any conventional two-way distribution. The universal-bracket hood suspends the luminaire vertically to light a 40-foot band along the fence, or permits tilting to light an approach area up to several hundred feet wide. Tilt permits the patrol area back of the pole line to be in comparative darkness; the guard, screened from the intruder by the direct beam of the luminaire, has a clear view across the shadowless area.

Look over the situation in your territory. You'll find an increasing demand for better-than-ordinary protective lighting. Why not let a G-E lighting specialist show you how to get it on your next job? Just call or write our nearest office. ***General Electric, Schenectady, N. Y.***

A. Form 79VR luminaires spaced 150 feet apart and 12 feet back of the fence line put a uniform level of illumination on every foot of the boundary.

B. Guards have a clear view down the fence line. There are no dark shadows to offer concealment.

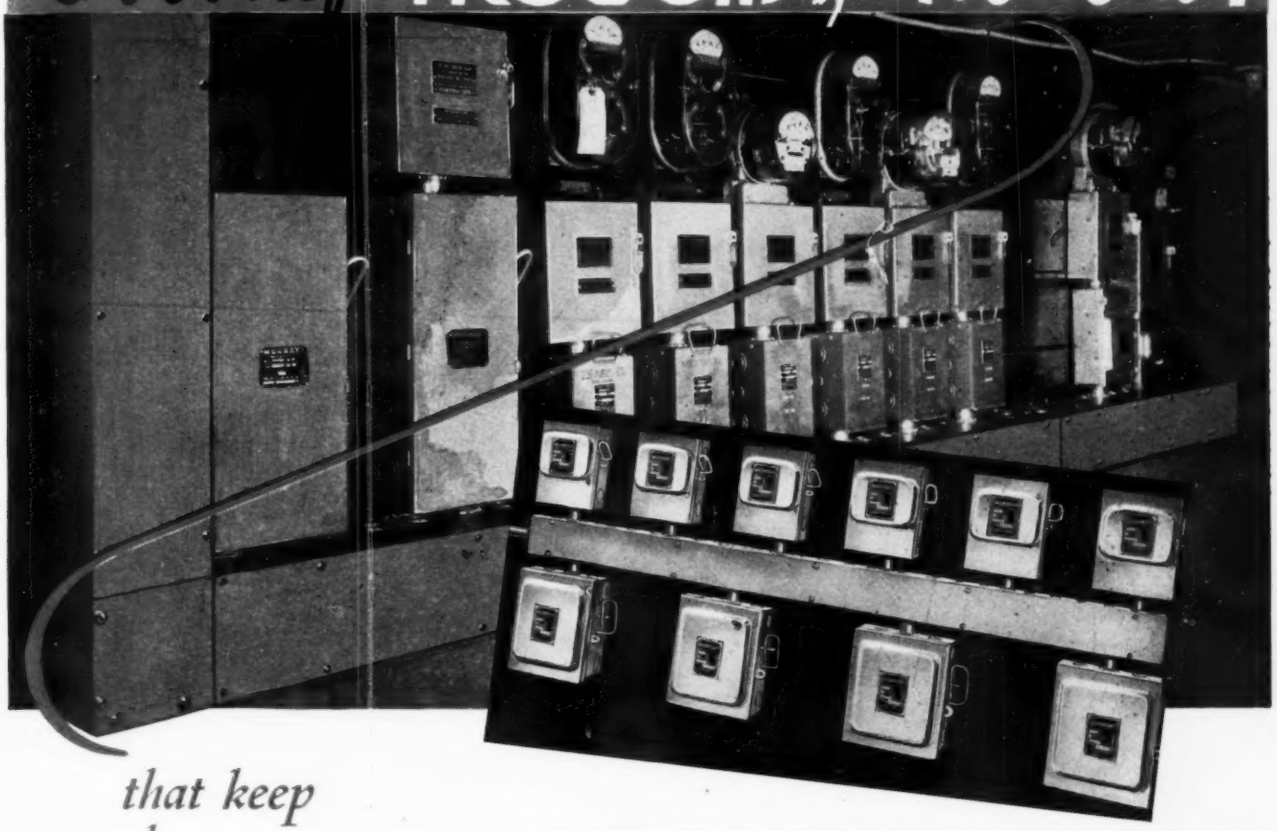
C. Day view shows how luminaires are tipped to illuminate a wider area.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie works for the manufacture of naval ordnance.

GENERAL ELECTRIC

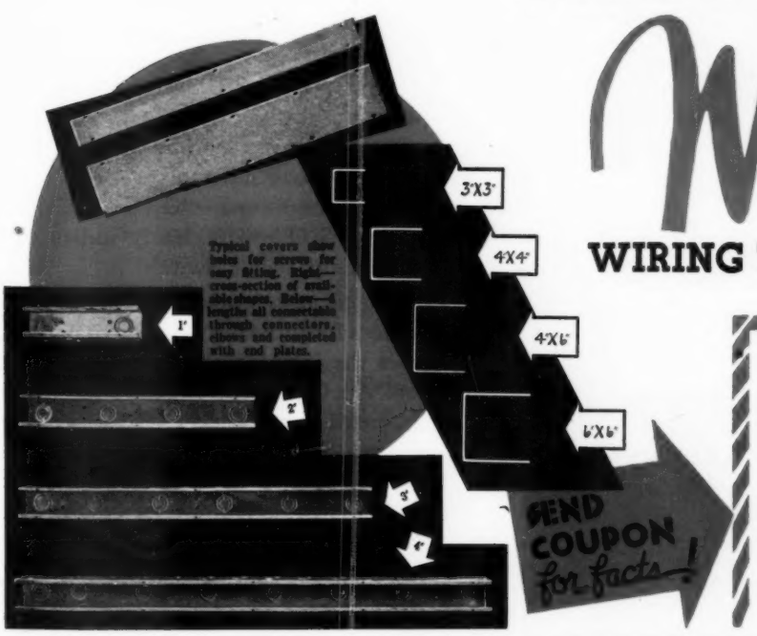
451-58-3200

Wiring TROUGHS by Murray



that keep the
TOUGHEST "GANGS"
in line

No matter how complicated, how long or how many turns (ever-ready elbows do the trick), Murray Wiring Troughs are easy and quick to install. They are strong and rigid when in place, yet easy to get into, through instantly removable covers. Tap for a branch anywhere—always a knockout handy. Four lengths—and four depth-width combinations. The installations above are typical—and the first you put in will look just as shipshape and prove the easiest job you can remember. Metropolitan Device Corporation, Brooklyn, N. Y.


3"X3"
4"X4"
4"X6"
6"X6"
Typical covers show holes for screws for easy fitting. Right—cross-section of available shapes. Below—4 lengths all connectable through connectors, elbows and completed with end plates.
SEND COUPON for facts!

Murray
WIRING TROUGHS for "ganging"

Metropolitan Device Corp.
Brooklyn, N. Y.

Please send catalog of
Murray Wiring Troughs.

Name_____

Company_____

Address_____

ELECTRICAL CONTRACTING. Published monthly, price 50 cents a copy, Vol. 41, No. 7. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription Rates—U. S. A., and Latin American Republics, $2.00 a year, $3.00 for two years, $4.00 for three years. Canada $2.50 a year, $4.00 for two years, $5.00 for three years. Great Britain and British Possessions, 18 shillings for one year, 36 shillings for three years. All other countries $3.00 a year; $6.00 for three years. Entered as second-class matter August 29, 1936, at Post Office at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. Copyright 1942 by McGraw-Hill Publishing Company. Cable address: "McGrawhill, New York." Member A. B .P. Member A. B. C.

THIS STARTER THAT SAYS:

Motor Watchman
Class 10-100
Size 1

"I'm 'on'
I'm 'off'
I'm 'tripped'"

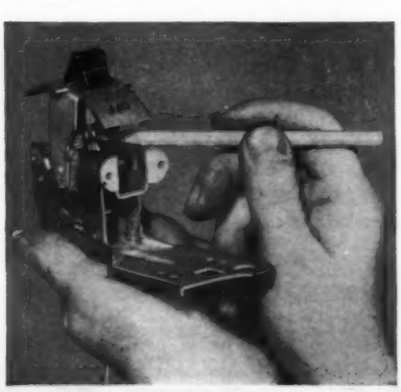
SAVES TIME SAVES MISTAKES!

WESTINGHOUSE "De-Ion" MOTOR WATCHMAN MANUAL STARTERS FOR A-C MOTORS UP TO 7½ HP

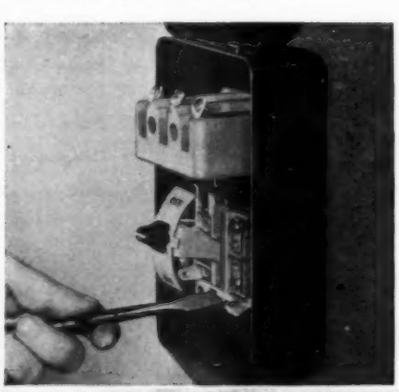
No question with the Motor Watchman, whether it is "ON" or "OFF," or whether an overload has caused it to trip and disconnect the motor. ALL THREE circuit conditions—"ON"—"OFF"—or "TRIPPED"—are clearly indicated by the handy toggle switch.

Toggle switch operation makes jogging motors for indexing easier, too. One hand does the job—quickly, accurately! "De-ion" Arc Quenchers prolong contact life—Bi-metal overload relay gives unvarying, factory-calibrated protection—straight-through wiring and keyhole mounting holes make installation easy. Order from your nearest Westinghouse Agent today. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

QUICK-MAKE as well as quick-break action prevents "teasing" of contacts. Contacts cannot be held partially closed. Arcing is reduced—contact life lengthened.

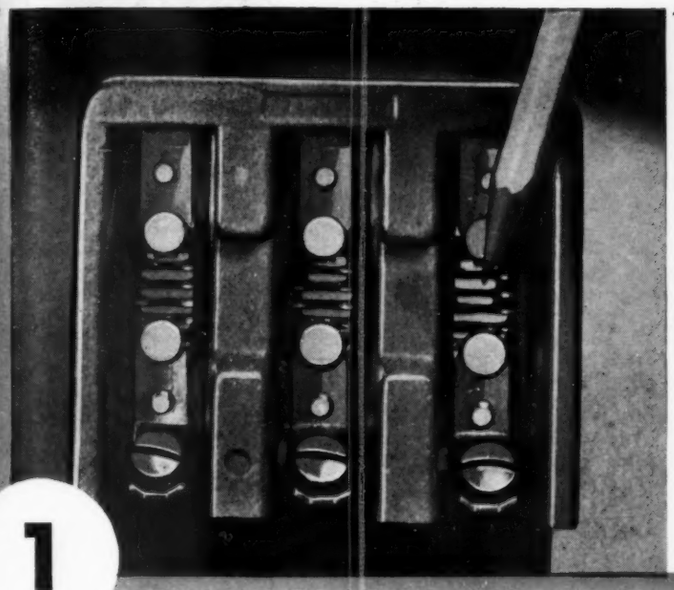


EASY TO INSTALL... terminals are out in the open, easy to get at. Through wiring, together with ample wiring space makes installation quick and simple.



Westinghouse

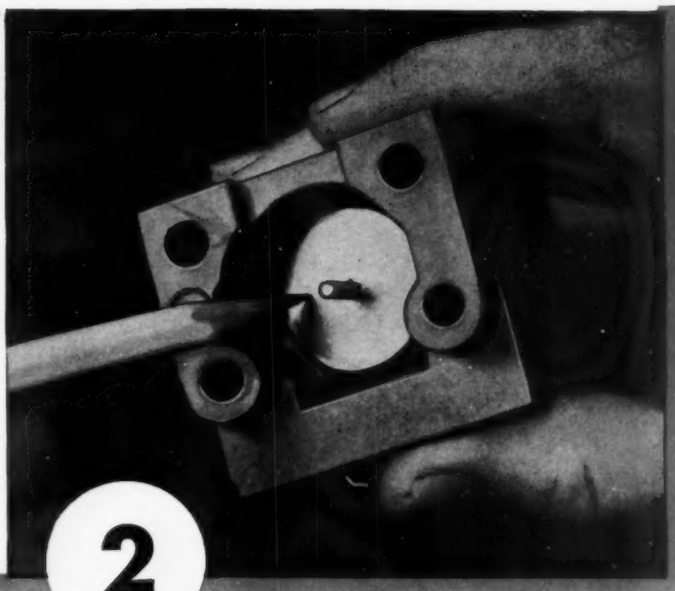
THESE TWO FEATURES IN WESTINGHOUSE CONTROL DEVICES MEAN added protection FOR ESSENTIAL MOTOR DRIVES!



1

"De-ion" ARC QUENCHING

"De-ion" arc quenching—an exclusive Westinghouse feature—increases life of contacts and reduces need for maintenance. "De-ion" grids confine, divide and extinguish the arc in one-half cycle, protecting contacts from excessive pitting or burning.



2

BI-METAL ACTION

Snap-action Bi-metal disk provides positive protection suited to the requirements of the motor drive. Accurate, factory calibrated inverse time action permits harmless overloads, but opens circuit with rifle-bullet speed on dangerous overloads.

Drives that are essential to today's production need the added assurance against shutdown that these two distinctive Westinghouse developments provide in Westinghouse protective and control devices.

These two features of Westinghouse design insure longer contact life, less need for upkeep and maximum protection for machines and men. Get them in Westinghouse control equipment—use them wherever essential drives must be kept turning! Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

J-21183

THERE'S A "De-ion" MOTOR WATCHMAN FOR EVERY TYPE OF JOB

Standard sheet steel dust-resisting enclosure (pedestal-mounted for use as a loom switch).

Water and dust-tight enclosure for outdoor and wet locations.

Explosion-protecting enclosure for hazardous locations.

e Motors and Control

WESTINGHOUSE

NOW...MORE THAN EVER...
YOUR CUSTOMERS *NEED* THIS REGULAR TELETALK PREMIUM

Speed is the order of the day . . . time the most precious raw material of all. You can show your customers how to gain time with Teletalk, and make a three-way profit—from labor, materials, and Teletalk—in the bargain.

Saving time has always been the prime sales point with Teletalk, and demonstrating Teletalk has always been the most direct way of putting that sales point across. That's why we urge you to demonstrate Teletalk now. You do business every day with people who are producing for war or essential civilian needs. The complete Teletalk line of models and special features enables you to satisfy the intercommunication requirements of the people who make up your market, whether their businesses are large or small.

WEBSTER ELECTRIC **Teletalk**
REG. U.S. PAT. OFFICE

They'll be glad to learn, too, of the quick installation, low operating cost, and quality for long years of service that are part of the Teletalk story. If you are not already familiar with Teletalk Amplified Intercommunication, the nearest Teletalk distributor can give you the information you need . . . or write direct.

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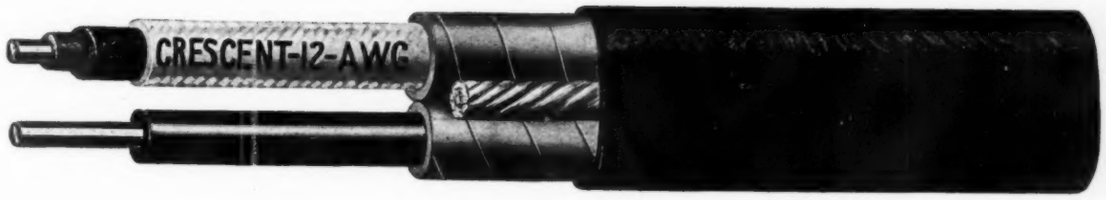
WEBSTER ELECTRIC

"Where Quality is a Responsibility and Fair Dealing an Obligation"

VARNISHED CAMBRIC · RUBBER POWER CABLES · BUILDING WIRE · RADIO WIRES · SIGNAL CABLE · FLEXIBLE CORDS · LEAD-ENCASED AND PARKWAY CABLES · ARMORED CABLE · CRESFLEX NON-METALLIC SHEATHED CABLE · SERVICE ENTRANCE CABLE · MAGNET WIRE · BARE WIRE

CRESCENT



WARFLEX

A NEW Product!
Uses NO Rubber!

This new, factory-fabricated cable has been developed in response to the need for a wiring method that eliminates the use of rubber. WARFLEX is especially suited for Cantonments and War housing.

Send for Further Information and Prices

A Partial List of* CRESCENT *Products

Building Wires & Cables	Synthol Synthetic Insulated Wires
Rubber Power Cables	CRESFLEX Non-metallic Sheathed Cables
Varnished Cambric Cables	Bare and Weatherproof Wires
Parkway Cable	Portable Cords and Cables
Signal & Control Cable	Flexible Steel Conduit
ABC Armored Cable	All other Standard Wires & Cables

CRESCENT INSULATED WIRE & CABLE CO.

CRESCENT
WIRE and CABLE
Factory: TRENTON, N. J.—*Stocks in Principal Cities*

CRESCENT ENDURITE SUPER-AGING INSULATION · WEATHER-PROOF WIRE

How to PROVIDE PLANT POWER QUICKLY

Take these 3 simple steps and you can order switchgear equipments and unit substations at an early stage of construction—*save weeks of time.*

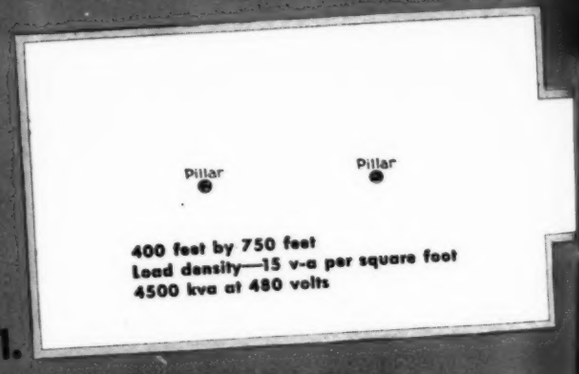
1. ***Calculate the total kva you need*** Load densities commonly range from 5 to 25 volt-amperes per square foot of floor area. Assembly areas usually fall in the lower range, intensive manufacturing areas in the upper range. Your consulting engineers can help you to predict your load density accurately.

2. ***Divide the load area into separate load zones of 500, 750, or 1000 kva***

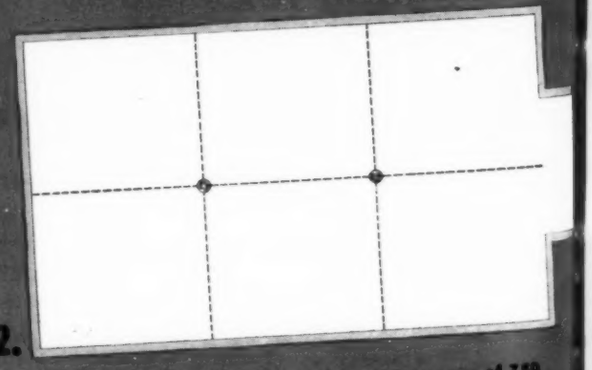
3. ***Divide the load of each zone into feeder loads***—and draw a one-line diagram of your proposed load-center system, showing the functions to be performed and the ratings required.

Now, with this one-line diagram, you can immediately order your switchgear and unit substations.

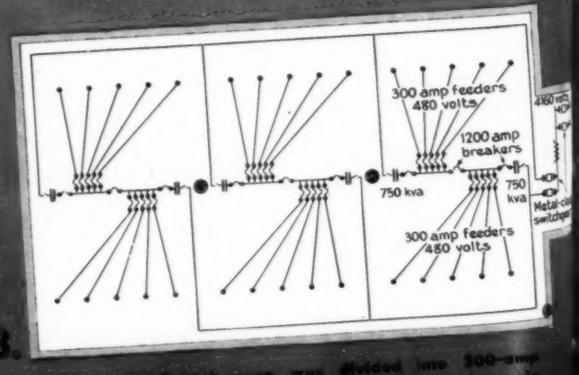
Here's How Equipment Was Ordered for This Industrial War Plant Now under Construction



1.

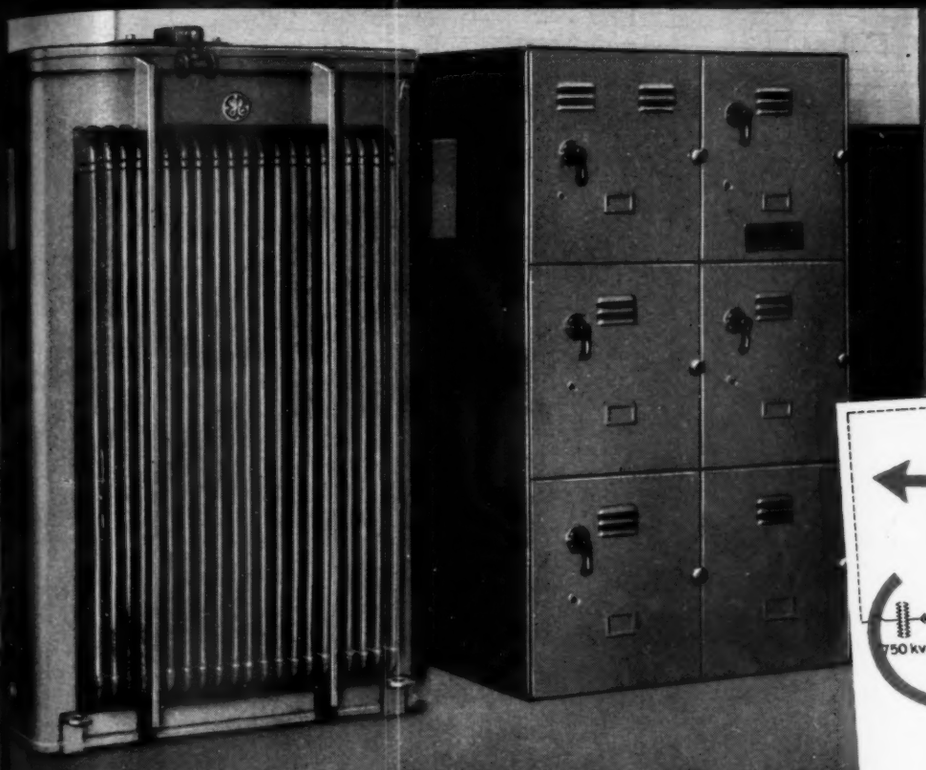


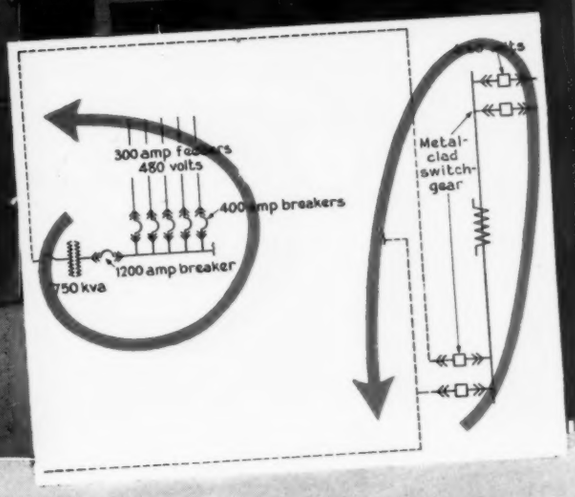
2. The load area was divided into six load zones of 750 kva each.



3. The load of each zone was divided into 300-amp feeders, each zone having 1200-amp breakers for main and bus-tie service. Equipments were ordered promptly by means of a one-line diagram.

A SIMPLE ONE-LINE DIAGRAM PUTS US TO WORK ON STANDARD EQUIPMENTS

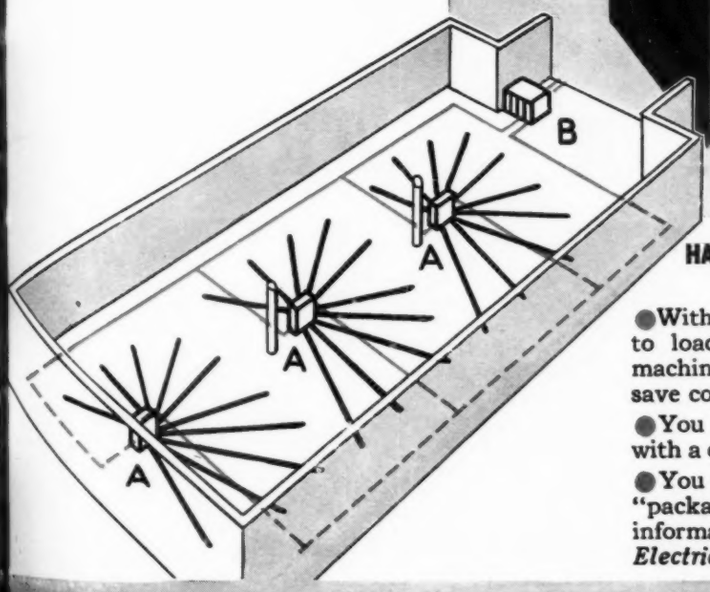




A *Load-center Unit Substations*—including transformer and high- and low-voltage protective and disconnecting devices, all co-ordinated as a single, safe, compact, easy-to-install unit.

B *Metal-clad Switchgear Equipments*—for protecting primary circuits up to 15 kv. A safe, co-ordinated assembly of breakers, instrument transformers, buses, and associated equipment.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.



HAVE LOAD-CENTER POWER BEFORE THE FIRST MACHINE IS READY TO ROLL

●With load-center distribution, power at high voltage goes right to load-center unit substations, and then directly to your machines through *short* low-voltage secondary feeders. You save copper, steel and dollars.

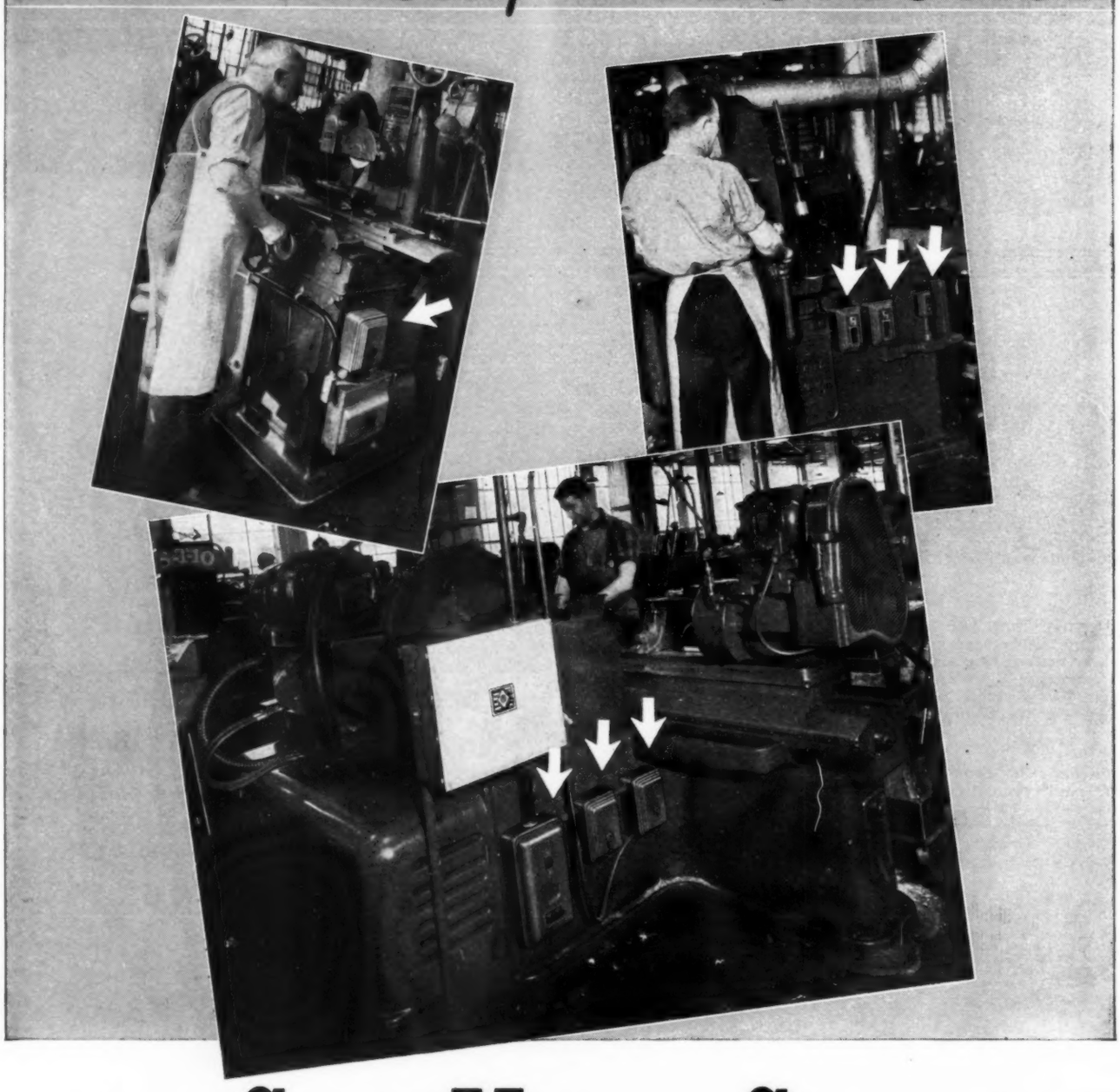
●You can order *standard* G-E load-center equipments *early*—with a one-line diagram. Get everything you need—weeks sooner.

●You get them ready to set in place and connect—in compact "packages" that can be put in otherwise "dead" area. For full information, contact your nearest G-E Office, or write *General Electric, Schenectady, N. Y.*

GENERAL ELECTRIC

264-17-7300

PRODUCTION *plus* PROTECTION



With COLT MOTOR CONTROLS

Colt Motor Controls are built to "take it" under today's grind of 24-hour-a-day production schedules. All shifts can depend upon the design and rugged construction of Colt Controls for full-time, full-speed operation.

THERE IS A COMPLETE LINE OF COLT MOTOR CONTROLS

Manual Motor Starters
Manual Reversing Starters
Manual 2-Speed Starters
Magnetic Contactors - Magnetic Motor Starters
Magnetic Reversing Contactors and Starters
Multi - Speed Starters - Relays
Combination Starters - Push Button Stations

COLT'S PATENT FIRE ARMS MFG. CO. - Electrical Division - HARTFORD, CONN.

JUNK

—you've got what it takes

THAT old junk -- useless to you -- may provide the extra implements of war to insure Victory -- your old iron and steel, copper, brass, rubber, even burlap, paper and grease.

Take steel, for example. Every hundred pounds of scrap you turn in will help produce one more powerful demolition bomb to speed the destruction of those plants that enable the Nazis and Japs to prolong the war.

To make the steel for a large tank, 10 to 15 tons of scrap are needed. And one badly needed "sub-chaser" takes many carloads of scrap.

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now, -- that's why the junk you can turn in is so vital to America's war effort.

THE YOUNGSTOWN SHEET & TUBE COMPANY

Youngstown, Ohio

★ ★ ★ ★ ★ ★

"WASTE NOT — WANT NOT" YOUNGSTOWN

METAL MOLDING WIRING SAVES STEEL

FOR WALLS

FOR EMERGENCY REWIRING IN OFFICES, FACTORIES, STORES, SCHOOLS, ETC.

2 PIECE—CAP SNAPS OVER BASE

INVISIBLE FASTENING

WIRES LAID IN—NO FISHING

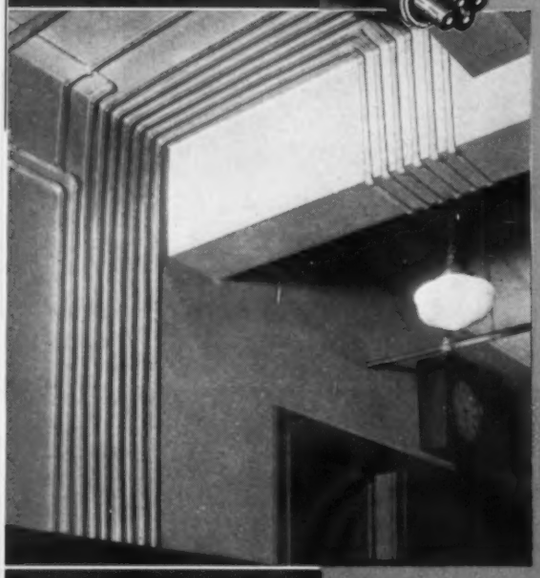
COMPLETE LINE OF FITTINGS FOR ANY REQUIREMENT

BENDS AROUND OFFSETS OR COLUMNS

ALL FIVE RACEWAYS ARE INTERCHANGEABLE

APPROVED BY UNDERWRITERS' LABORATORIES, Inc.

FOR FLOORS



1000 FEET 333 METAL MOLDING
Weighs 410 lbs.
(Will hold 4 No. 12 or 14 Wires)

1000 FEET

1" Conduit weighs	1684 lbs.
1" E.M.T. weighs	711 lbs.
1" Flexible Steel Conduit weighs	1020 lbs.

METAL MOLDING SAVES STEEL

Write for Catalog and Handbook

NATIONAL ELECTRIC PRODUCTS NE METAL MOLDINGS 6 WIRES AND CABLES

Electrical Contracting

With which is consolidated The Electragist and Electrical Record . . . ESTABLISHED 1901

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A PRACTICAL PAPER for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

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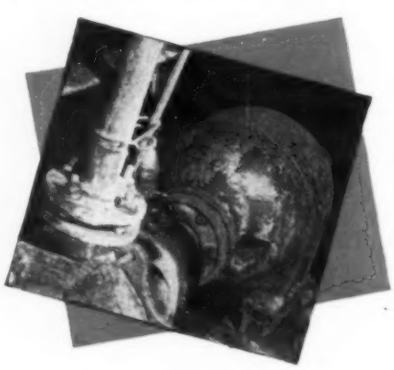
NEED MOTORS 4 things to do

use standard, open, sleeve-bearing motors whenever possible . .

The standard Tri-Clad motor, though classed as an "open" motor, is so well protected that it gives good service on many jobs for which specially protected motors previously were recommended. (See below.)

Sleeve-bearing motors often can be supplied more readily than ball-bearing types because of the present demand for ball bearings on other war equipment. Use ball-bearing motors only on applications where load or mounting conditions definitely require them.



Special end shields and other modifications may result in delay for you and others doing war work.

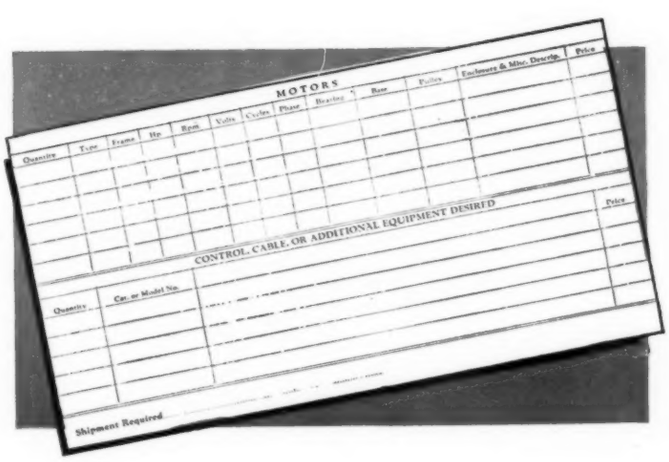
Consider the use of standard or multi-speed a-c motors in place of d-c wherever this alternative is possible.

order motors early . . giving complete specifications . .

Place motor orders when you order the machines they are to drive.

If you are planning motor drives for conveyors or other equipment for new plants, place orders as soon as design work indicates the motor requirements.

Avoid delay and "mix-ups" by giving complete specifications as shown in table below, preferably on an order form which your G-E motor representative can supply.


MOTORS

Quantity	Type	Frame	Hp	Rpm	Volts	Cycles	Phase	Bearing	Base	Pulley	Enclosure & Misc. Descrip.	Price

CONTROL, CABLE, OR ADDITIONAL EQUIPMENT DESIRED — Price

Quantity	Cat. or Model No.	

Shipment Required

Tri-Clad motors are available in a full range of sizes from 1 to 100 hp. Your General Electric representative can supply complete information, and help you get the Tri-Clad motor to do your job. General Electric, Co., Schenectady, N. Y.

YOUR AID ON THESE 4 POINTS WILL HELP US PRODUCE AND DELIVER MORE MOTORS

YOUR CHOICE OF G-E TRI-CLAD MOTORS WILL GIVE YOU EXTRA PROTECTION AGAINST (1) PHYSICAL DAMAGE, (2) ELECTRICAL BREAKDOWN, (3) OPERATING WEAR.

for WAR WORK?
to get them quicker

give complete priority information properly endorsed..

The filling of many motor orders is delayed because of incomplete priority information. If in doubt about details, call your local G-E office.

When placing orders for motors, be sure that complete priority data accompanies *each order* in the form of certificates, endorsements properly signed, etc. The priority is not effective in scheduling shipment until received by your supplier.

Your needs and the war effort are best served by using the proper priority rating as assigned by the War Production Board for the job involved and requesting delivery no earlier than actually required.

Builders of motor-equipped machines for subsequent sale may order their requirements in advance under the Production Requirements Plan.

check with G. E. for delivery from local warehouse stocks..

To meet urgent war needs, a supply of standard Tri-Clad motors is maintained at G-E factories and local G-E warehouses. Perhaps the motor you want, or can use with a few simple changes, is available for immediate shipment.

Your local G-E motor representative can furnish information on motors which may be in stock in the following cities:

Atlanta, Ga.	Los Angeles, Calif.
Boston, Mass.	Milwaukee, Wis.
Buffalo, N. Y.	Minneapolis, Minn.
Charleston, W. Va.	New York, N. Y.
Chicago, Ill.	Oklahoma City, Okla.
Cincinnati, Ohio	Omaha, Neb.
Cleveland, Ohio	Philadelphia, Pa.
Dallas, Texas	Pittsburgh, Pa.
Davenport, Iowa	Portland, Ore.
Denver, Colo.	St. Louis, Mo.
Detroit, Mich.	Salt Lake City, Utah
Houston, Texas	San Francisco, Calif.
Kansas City, Mo.	Seattle, Wash.

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Sunex Securityflex*, a product of Anaconda research developed to withstand not only the rough and tumble conditions of underground mining but also the sun blistering service of open pits, is the "tail" that's wagging many mining dogs. And the research that built it, the invaluable hours of patient experimenting and testing, now speeds to develop copper wires and cables for an even more potent war effort . . . for a greater industrial front . . . for use in mines, in war-vital plants, in bombers and battleships. 4224J

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Electrical Contracting

CONVERSION COMPETITION

Free price competition brings progress. It contributes to the survival of good management and audacious method. It automatically discards the inefficient, the wasteful and the unprogressive. But that kind of free competition implies intelligent direction, specification, and understanding or it breaks down when its beneficial results are needed most.

Under war time conditions, direct price competition has an important place in checking the inflationary trends on great construction projects where bidders are few and specifications are rigid. But the problem in this field is purely economic.

In the thousands of industrial conversion jobs contemplated and in progress, however, there is a new element of far greater importance than price. Electrical work requires precious, scarce metals. These metals must be used to provide the maximum immediate benefit to the war effort. A relatively minor difference in the amount of new copper proposed in the bids of two competing contractors deserves more urgent consideration than any difference in price.

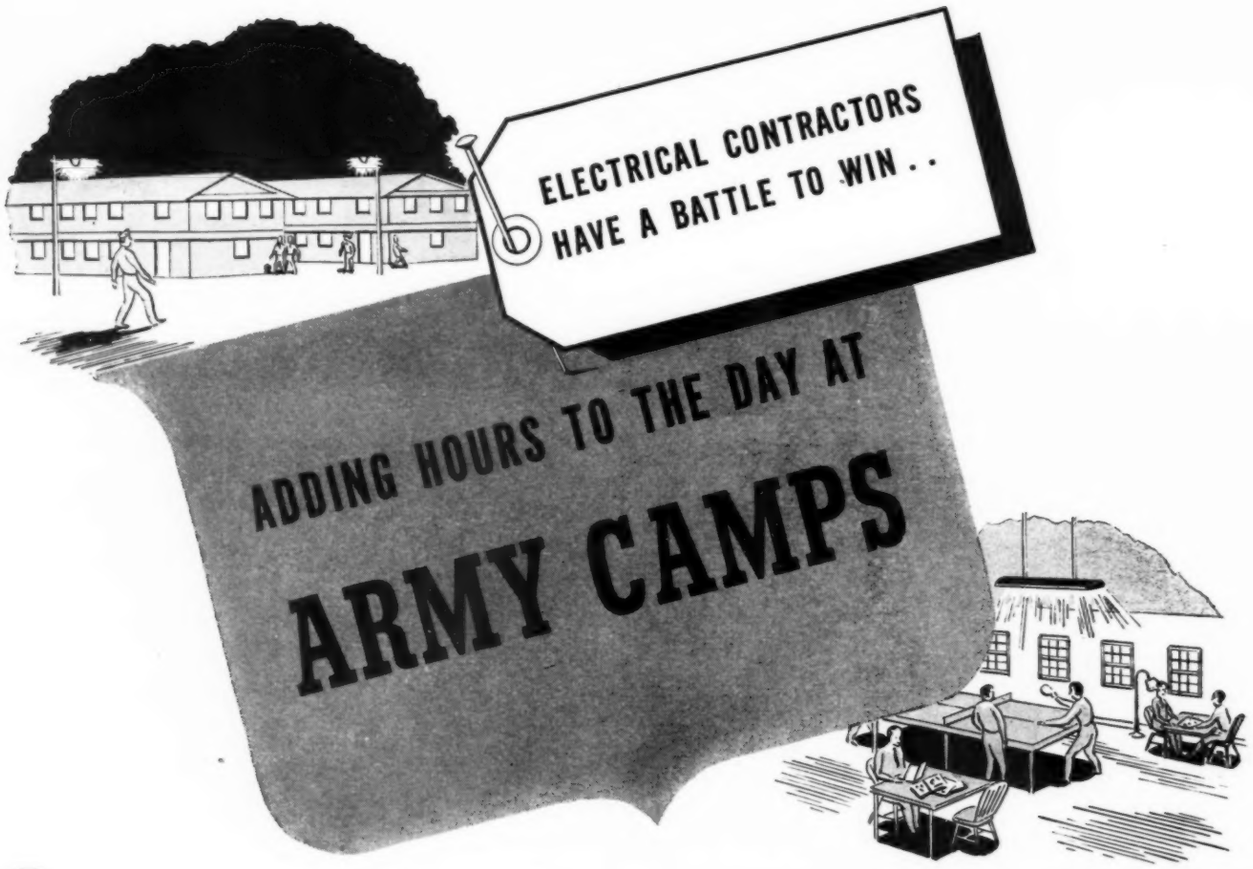
In normal times we curse the "open" specification. It lets in all the cats and dogs. It encourages low quality material, barely passable workmanship and rule of thumb design. It fosters shopping and corner cutting. All because the emphasis is on price.

But today, the "open" specification, with price recognized as secondary to skillful utilization of existing equipment, has a vital place in conversion work. It allows the estimator to exercise his years of experience and his broad knowledge of electrical wiring design and method, not to reach a price, but to re-use all the existing resources of wiring and apparatus and to apply new materials for maximum immediate utilization.

The re-use, under expert planning, of existing wiring and equipment that we are talking about here is not the simple job of reconnecting a motor or dusting off an old pull box. It involves rehabilitation, rebuilding and the restoration of available materials to sound mechanical and electrical efficiency. It involves the inter-relation of new equipment with existing materials to save as much as possible in scarce materials in terms of the whole job and the machines and processes it must serve.

It is a recognized truth among electrical estimators that such re-use of existing materials in an existing building is frequently more expensive than a clean new job. This, coupled with price thinking, has unquestionably inhibited the full utilization of existing facilities in converting plants to war work.

This is fundamentally a selling job; first, to convince management of the value of an "open" specification for complex conversion work; second, to produce a clear presentation of the proposed work that will high-light the strategic economies; and third, to gain consideration for competitive advantages other than price. That will not be easy. But it can be done.



CONSTRUCTING a modern army camp means building a self-contained city, using electricity in all the ways that it can add to the efficiency, safety and comfort of the men.

Outdoor lighting is a big job, involving street lights, floodlights, fence lights, searchlights and the like. *Indoor lighting* in barracks, mess halls, recreation halls and other buildings must provide good seeing for men whose eyes are precious. *The wiring job* must meet demands for more and more electrical equipment and appliances in kitchens, hospitals, offices and training shops.

Instantaneous *communication* within the camp means more work for the electrical contractor. Fire alarm systems and warning signals may also be called for. Taken together, it's the kind of a job that can be quickly solved only when the local electrical contractor takes a hand in it.

No matter what the job you're tackling . . . industrial conversion . . . shipyards . . . air bases . . . defense housing . . . don't forget that GRAYBAR offers you the strongest possible *local* aid on equipment and supplies.

More than 200 manufacturers of the equipment frequently specified for these and other war jobs depend on GRAYBAR to speed their products to the point of need. Thanks to a nationwide experience on such jobs, your local GRAYBAR man can help you fulfill war contracts promptly and at a profit.

These Graybar-distributed products are widely used on Army Camp Jobs

Crouse-Hinds, Benjamin **and** ***General Electric*** **outdoor lighting equipment—searchlights, floodlights, street lights, etc. Incandescent and fluorescent lamps and fixtures for every type of indoor lighting need.**

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Graybar **Inter-Phones,** ***Webster Electric*** **Teletalk,** ***Edwards*** **Lokator and other signaling and alarm equipment.**

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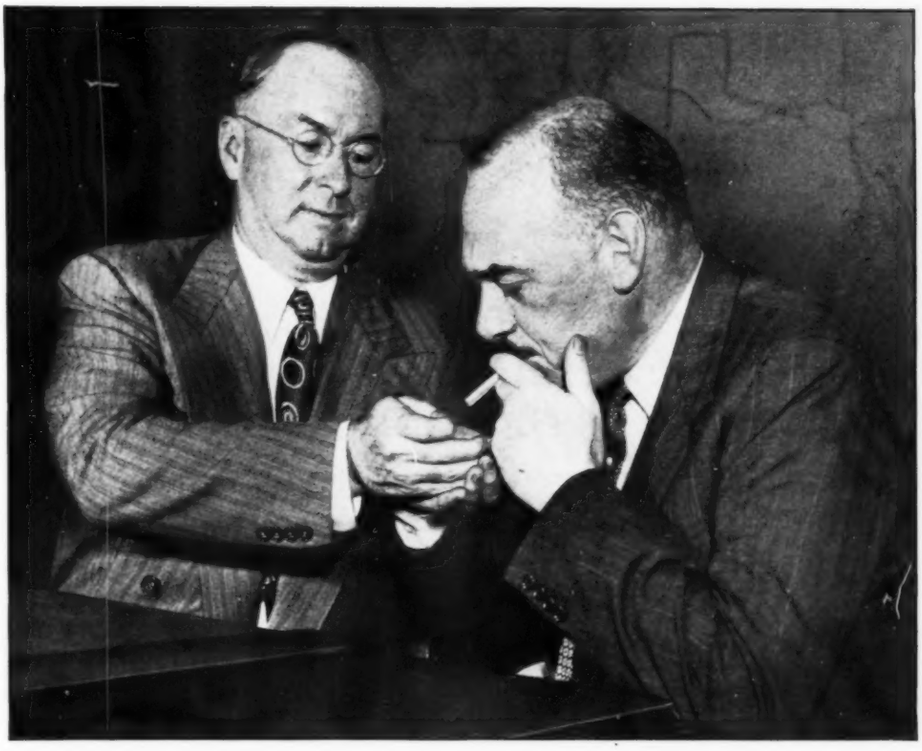
The Story That Must Be Told



Two men who know the story best: Donald Nelson, Chief of the U. S. War Production Board, and (right) Oliver Lyttelton, Great Britain's Minister of Production.

BETWEEN THE LINES of today's war news is written a story that is even more vital than the news itself. For through that story we begin to discern the pattern of victory, not yet complete in all its details but increasingly clear in its essentials.

It is the amazing story of how American industry has responded to the call for the weapons of total war, of how its technicians, workers, and managers are driving through an unprecedented task of fantastic size and complexity.

France fell in June 1940. During that month this country produced about $150,000,000 in war goods. By June 1941 the Nazis had overrun the Balkans; and in that month our war production was $800,000,000. The fateful month of December 1941 gave us an output of $1,800,000,000—an increase better than tenfold in eighteen months. And in May 1942 our total expenditures for war equipment and supplies mounted to the staggering total of $3,500,000,000.

This is an increase of twentyfold within two years, of itself a stupendous industrial achievement. But what is even more important, that achievement already is making itself felt the world over—in the Orient, in Australia, in Libya, in Europe, in the Coral Sea, at Midway Island, at the Aleutians, and wherever else we find a battlefront manned by free men.

To accomplish it, many industries have been pouring out war materials at a rate that only six months ago did not seem even remotely possible. Starting from scratch, our factories have turned from their peacetime jobs, first to meet and then to surpass the most hopeful estimates of what might be expected of them.

To do this they have drawn heavily upon all of their resources. Their skilled and unskilled

man-power has thrown into the task a war-born will to work; their research staffs have bent to it all of their scientific resources; their engineers have applied to it their utmost ingenuity; their executives have devoted to it the full measure of that managerial skill which has won for American industry the respect of the modern world.

For the first time in history we have pushed the accelerator of the world's greatest engine of mass production down to the floorboard. Always in times of peace, factory men have had to gear production to what the markets would take. But now the market they are called upon to serve is hungry for the last ounce of potential output. For war confronts industry with a demand limited only by its capacity to produce.

During these feverish months, while a desperate world has watched breathlessly to see how American industry would perform as the arsenal of democracy, we of McGraw-Hill have followed with mounting pride — at times almost with wonder — a new miracle of industrial achievement.

Some day the full story of this American industrial effort will fill a brilliant chapter in the epic history of our times. Meanwhile it would be premature to celebrate the completion of this task. For victory has not yet been won; that still lies at the far end of a road that we may find to be long and arduous.

But even now we can be certain of one essential of that victory. American industry is doing its job; it is delivering all that the people have asked of it — and more.

As I have watched with my associates the unfolding of this picture, I have wished that it were possible to broadcast it, in full color and wealth of detail, to the people of America, so that they could understand at least, in part, the job their industry is doing for them. It would help, it seemed to me, if the men of industry themselves, each so intent on his own task, knew what their fellow-workers in other fields have been doing.

However, the managers of industry have been far too busy ***doing*** to talk. They are going to be just as busy for some time to come. Naturally, many details are yet to be spread upon the record and, indeed, the full story cannot be told. But that part of the story that can be told is well worth the telling and the hearing, if only for its revelation of the spirit of an awakened America, throwing its all into the fight against the tyranny that has brought so many of the world's little people under its heel.

The 1941 war production of the United Nations, exclusive of the United States, equalled the total 1941 war output of Germany with all of its captive plants and enslaved labor. Since Germany's 1941 operations were at maximum capacity no further increase is possible. British output has been expanding to the point where its 1942 production is considerably ahead of Germany's.

In May 1942 American war production passed the British output 50 days ahead of schedule. In 1943 it will be 3 times that of the British.

This has been brought about under the leadership of Donald Nelson and the War Production Board, the Army, the Navy, the Maritime Commission, with the cooperation of management and labor. It has been furthered by the cooperation of Oliver Lyttelton, British Minister of Production, and other British production authorities.

But the story goes far beyond that. It gives us a glimpse of the America as it will emerge from this war, its industries again setting world standards of production, which will become the spearhead of our post-war economy.

This is a story that cannot be adequately told in generalities. It must be told in some detail. For instance, the great accomplishments of the machine tool industry, the great forward strides made by the aviation industry, the tremendous achievements of the chemical industry, the amazing conversion of many industries will warm the hearts of Americans.

These aspects of the subject deserve the fullest treatment and will be told month by month in these pages until the story has been completely unfolded. We will try to give a concise overall picture of the war job that industry has done and still is doing. You will find it a thoroughly American story of high American achievement in which every American can take pride and from which every American can take hope for the future of his country.

The story is far too significant to be withheld any longer.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

POWER
For BOMBER PRODUCTION

By Herman Winte

Electrical Engineer, Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

Reliable power supply, the lifeline of industry, is assured at Ford's new mass production bomber plant near Detroit. Auxiliary primary and secondary tie-lines interconnect underground substations. Total underfloor distribution frees the entire plant area for cranes, conveyors and assembly line equipment.

ONE death-dealing bomber per hour is the seemingly incredible goal at the Ford Motor Company's new bomber plant just outside of Detroit. But then, nothing is incredible in the city where production miracles have frequently been performed by the automotive industry. Now mass production is being applied to heavy bomber production.

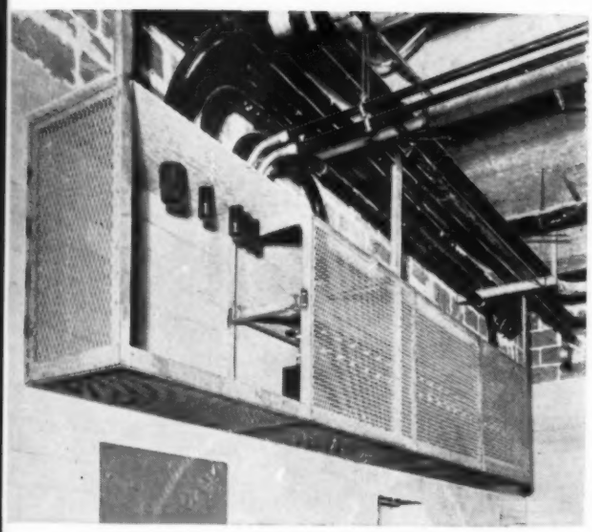
Already a construction engineer's dream has become a startling reality. From Michigan farm lands has arisen the largest workshop in history—a production giant that houses hundreds of tons of machinery and miles of conveyors and assembly lines, all under a single roof. Designed by Albert Kahn Associated Architects and Engineers, Inc., of Detroit and built by Bryant & Detwiler Co., Detroit, this plant projects mass production of bombing planes beyond the realm of idle fancy into actuality. Raw materials will enter one end and at the other end, the 30-ton monsters of destruction will roll off half-mile assembly lines so fast that storage will not be attempted. The planes will be ranked on the huge airport adjoining the plant, given test flights and flown to their destinations.

Interconnected Electrical System

What makes the inner workings of such a huge plant tick? What keeps the wheels turning so that every 60 minutes may herald the birth of a new bomber? The answer, as in all industry, is the electrical system—the vital lifeline of thousands of miles of copper conductors over which kilowatts travel to the smallest of motors. This system, installed by the John Miller Electric Co., Detroit, has been as carefully designed as any structural member of the building. For, failure of a single feeder might jam the assembly lines and bottleneck production. Such failures and emergencies have been provided for in the electrical design and expense has been no barrier where production might suffer.

Duplicate and widely separated 120 kilovolt utility lines serve the plant, terminating in main outdoor substations. Secondary 13,800-volt power is distributed underground to a series of underfloor plant substations throughout the area of the building. These subfeeders emanate from four 13.8 kv. bus sections in the power house. The secondary from each of the two high voltage incoming transformer banks feeds two sections of the bus. All four sections

CENTRALIZED DISTRIBUTION *from column cubicles such as these is standard throughout the plant. Branch circuit conduits leave bottom of cubicle and will be concealed by wood block floor not yet installed. Individual panels serve separate systems*



CAPACITOR RACK *in each substation contains 300 kva. of static condensers in two banks. One bank of 150 kva. is permanently connected to buses; the other is automatically cut in as the load demands.*

TEMPORARY POWER *from this improvised switchroom in the power house enabled plane production to start before the entire plant was completed. Plant production followed on the heels of construction crews.*

are interconnected by an emergency 13.8 kv. tie bus, to provide power from either utility service to any one of the bus sections if an outage should occur. Also two 2,500 kw. turbo-generators on two of the bus sections can be synchronized with the utility lines or paralleled with either high line.

Additional reliability is added by limited looping of the substation secondaries. All substation transformers, both power and lighting, are interconnected on the secondary sides as illustrated in the one line diagram in Fig. 1. These interconnections between transformers fed from the same utility high line are accomplished through interlocked, normally open, air circuit breakers, thus preventing the tying together of substations fed from different utility services.

The Plant Substations

All underground factory substations are of the typical basement design and are located at centers of distribution throughout the building. Here is the heart of the radial distribution system serving the hundreds of column cubicles throughout the manufacturing area. A typical substation equipment layout includes a 2,000 kva., 13.8 kv./480-v., three-phase power transformer; one 1,000 kva., 13.8 kv./240-v., three-phase power transformer (in two substations only); a 750 kva., 13.8 kv./208/120-v., three-phase lighting transformer complete with network protector and secondary switchgear; a 250 kw., 240-v., d.c. motor-generator set for crane operation; two 60 kva., 240-v., three-phase, hi-cycle motor generator sets, one 180 cycle and one 240 cycle for high speed tools; and the necessary control, feeder and bus-tie cubicles.

The problem of ventilating these buried substations was solved by artificial systems. A fan room is built as an integral part of each station unit. Also included in each substation is a cable vault where the underfloor cables from the numerous substation cubicles are brought up in conduit risers and enter the fibre conduits in the plant floor slab to serve the numerous column cubicles. All substation conduits are completely concealed in the floor; between finished tile and concrete walls; or above the hung ceilings. All wall panels are flush mounted.

Power Factor Correction

A flexible means of power factor correction is designed in the power system. Each substation is equipped with 300 kva. of static condensers, divided into two banks of 150 kva., each. One bank is permanently connected to the system at all times; the other is thrown on the lines, as load demands, by magnetic contactors controlled by reactive-kva. meters. Finer control of plant power factor is accomplished through the installation of manually controlled banks of 15 kva. of capacitors at master welding and power panels. These banks are connected as the varying load on the system demands additional correction.

Proper coordination of these capacitor banks will correct the power factor to 95 per cent at full load, release copper capacity by absorbing the wattless power and raise the voltage at the feeder extremities. Automatic step-type voltage regulators at the master substation holds the bus voltage constant. The combination of regulators and capacitors will hold the voltage regulation to between two and three per cent.

Centralized Underfloor Distribution

The manufacturing areas of the plant are provided with maximum floor space by the use of centralized distribution and underfloor branch circuits. Overhead conduit or bus systems were not considered because of the vast amount of cranes, conveyors and assembly line equipment necessary for the mass production process.

The distribution centers consist of totally enclosed panel cubicles built around the steel columns. A typical center consists of a master panel which feeds five or six branch circuit panels in the group (see Fig. 2). Panel units

CABLE VAULT *riser conduits lead feeder and control cables from substation equipment up to fibre conduits in the plant floor slab. Vent duct is at upper left of photo.*

SUBSTATION CUBICLES *with rear panels off, showing the interconnecting tubular buses and enclosed busbar connections to the transformer at right.*

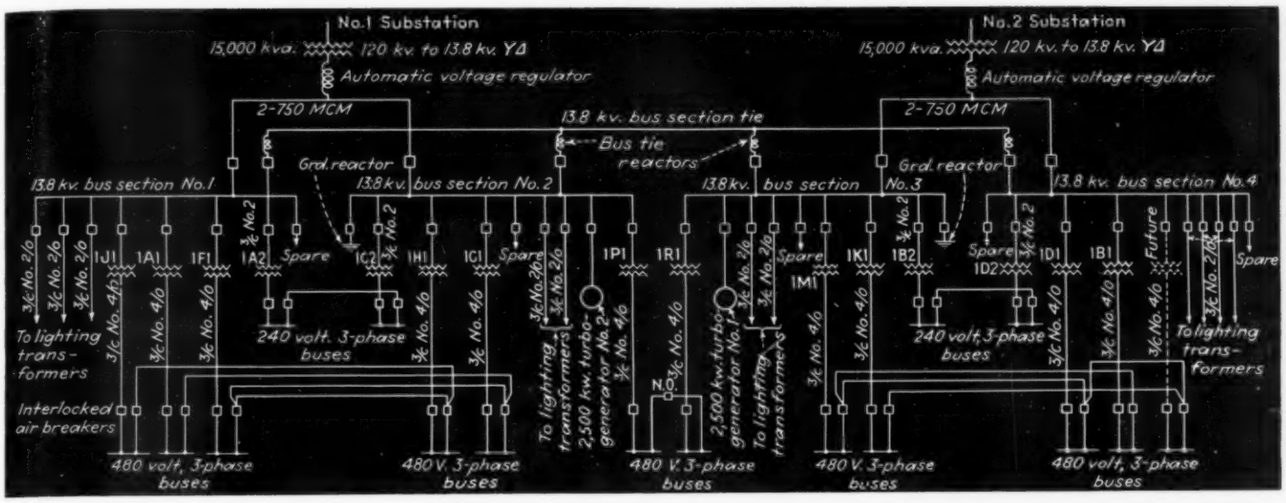


FIG. 1 SUBSTATION INTERCONNECTIONS *on both the primary and secondary sides provide a reliable power supply under emergency conditions. Interlocked secondary air breakers prevent tying together transformers fed by different high lines.*

are the dead-front swing-out type. These circuit panels might include power, lighting, direct current and hi-cycle circuits. Some of the cubicles in the congested machinery areas are equipped with convenience outlets for electric tools or extension hand lamps for servicing production machines. A number of these circuits are fused at the receptacles.

Master panel feeders are in the floor slab. Branch circuit conduits are run in channels cut into the 2½-inch wood block flooring on top of the concrete slab. Such chases are filled-in with concrete after the conduit has been installed. If a machine location is shifted, the concrete chase is easily chipped out and the channel refitted with blocks.

Concentrating a number of distribution panels at centralized locations such as this permits an increase in the number of panels that can serve a specific area without jeopardizing valuable space. The outer edges of the enclosing cubicles are rounded, eliminating injury hazards to employees and chance of damaging materials routed through such areas. Removable screw covers enclose a wiring space extending 20-inches above floor level.

Installation Problems

The installation methods used in this power work were no different from those employed in any ordinary "mud" job. Only in the underground substation work did a few problems arise. These were primarily due to the large numbers of feeder and control conduits that had to be buried in the floor slabs. In a few cases, such as the switchrooms in the power house basement, there were as many as 1,200 to 1,400 conduits in the slab. Here the slabs were more than three feet thick. Conduits were installed in layers; the heaviest ones grouted in first then covered with a layer of concrete; another layer installed and the process repeated until all were concealed.

One specific problem facing the electrical contractor, was that of maintaining conduit riser nipples rigid during the pouring of the thick slab, layer by layer. Wood and steel templates were used extensively. In some cases such templates had to be braced from opposite walls of the substation and double-tier templates were not an uncommon sight. Testimony as to the skill and accuracy of the mechanics making and bracing these templates was evidenced in the fact that no trouble was encountered in setting equipment over thousands of floor nipples.

Portable hand winches, with power attachments where necessary, helped to speed the installation of the feeder cables. These units were mounted on a portable hand truck, similar to a two-wheeled baggage truck, and could be pushed from place to place. When in use, they were securely chained to building columns.

Careful engineering, supervision and the latest electrical construction methods have combined to give the Ford bomber plant a practically foolproof electrical system designed to keep production rolling night and day.

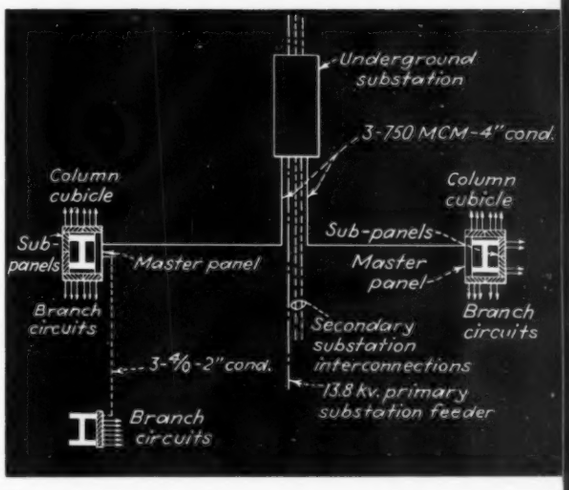
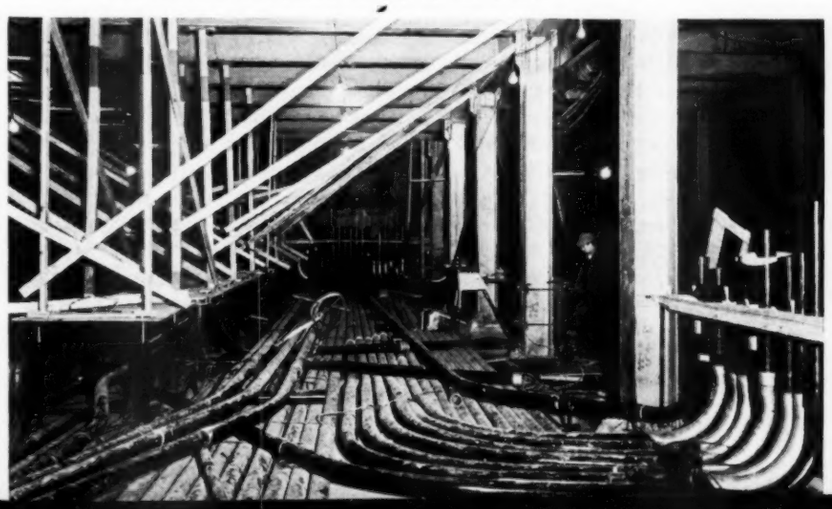
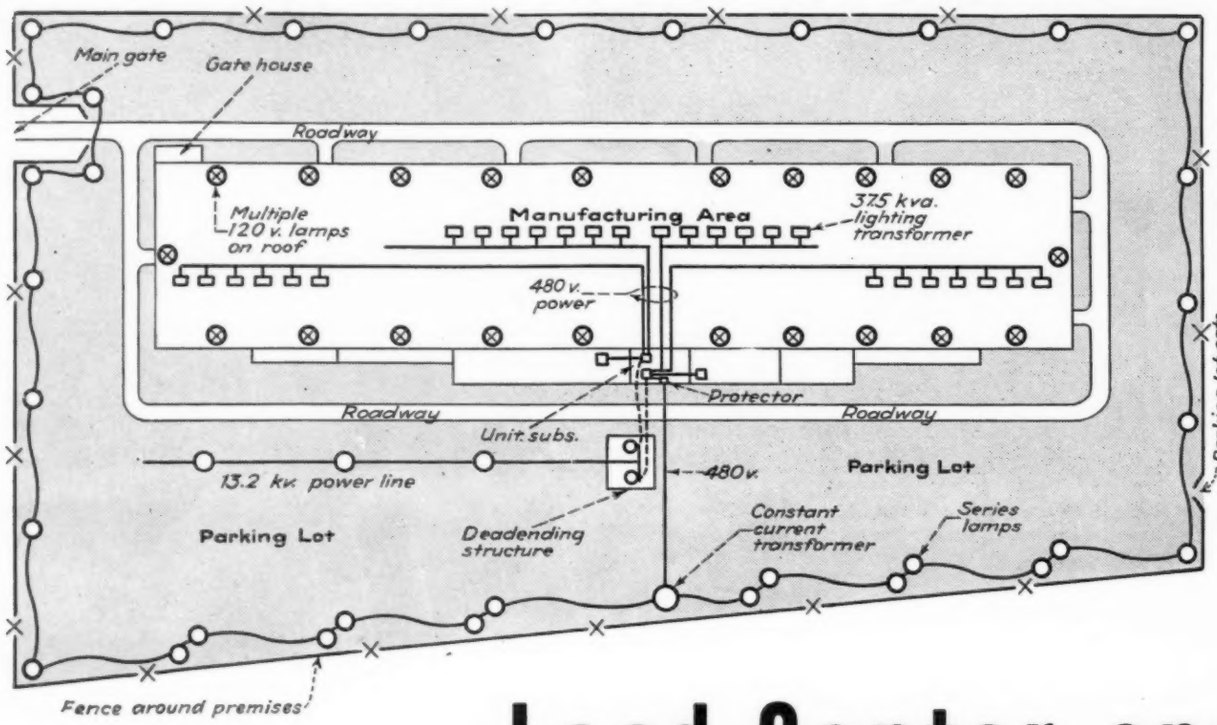


FIG. 2 RADIAL DISTRIBUTION *from underground substations feed column encircling cubicles containing a master panel and sub-panels for the different electrical systems.*

LAYERS OF CONDUITS *are installed in power house basement floor slab. Elbows and riser extensions are "spotted" by rigidly braced templates. Another layer of control conduits will follow on top of this pour.*



SUBSTATION AND FENCE *lighting layout showing 480-volt circuits feeding lighting transformers and a constant current series transformer for outdoor lights. (Figure 1)*



Load Center and SERVE LIGHTING

ALONG with other expansions in production facilities a large Eastern manufacturer recently placed in operation a medium sized assembly plant consisting of a 250- by 100-foot one-story building. This plant was erected before the war started and was one of the first to be built under the national defense expansion program. The urgency accompanying the erection of this plant was such that it was necessary to have the plant designed, built, and in operation in only four months time. This was accomplished by carrying on design and construction simultaneously. Among other things, these facts naturally called for the closest kind of cooperation between the contractor, purchaser, power company, and electrical manufacturers' representatives in order to assure installation of the power supply equipment by the time the plant was made ready to receive it.

The general arrangement and plot plan of the plant are shown in Fig. 1. The available power supply consisted of a single circuit 13.2-kv., three-phase, 60-cycle overhead line with generation at both ends. This line was owned and operated by the local power company. As soon as the expected factory load and the step-down substation arrangement were decided upon, a five year contract was immediately made with the power company for the purchase of primary power. Under the terms of the contract the power company tapped the 13.2-kv. line and ran it a distance of approximately two miles to the new factory site. Power was metered at the tap-off point. At the end of the tap-off line a two pole structure was provided to dead-end the line. Lightning arresters, disconnecting type fuses, and potheads were mounted on the structure. From this structure two sets of three single-conductor cables were run underground in conduit to the substation yard at the side of the plant building across the road.

Initially, it had been planned to utilize a conventional 2500-kva. substation with three 833-kva., single-phase transformers to step down from 13.2 kv. to 480 volts for distribution in the factory. At this point consideration was given to the use of two, three-phase, 1200-kva., factory-built load-center unit substations. From the continuity of service standpoint, the unit substation plan had the advantage that, in utilizing two small substations instead of one large one, an actual apparatus failure would tie up only half the plant load. In addition, the following interesting comparison of equipment prices was made:

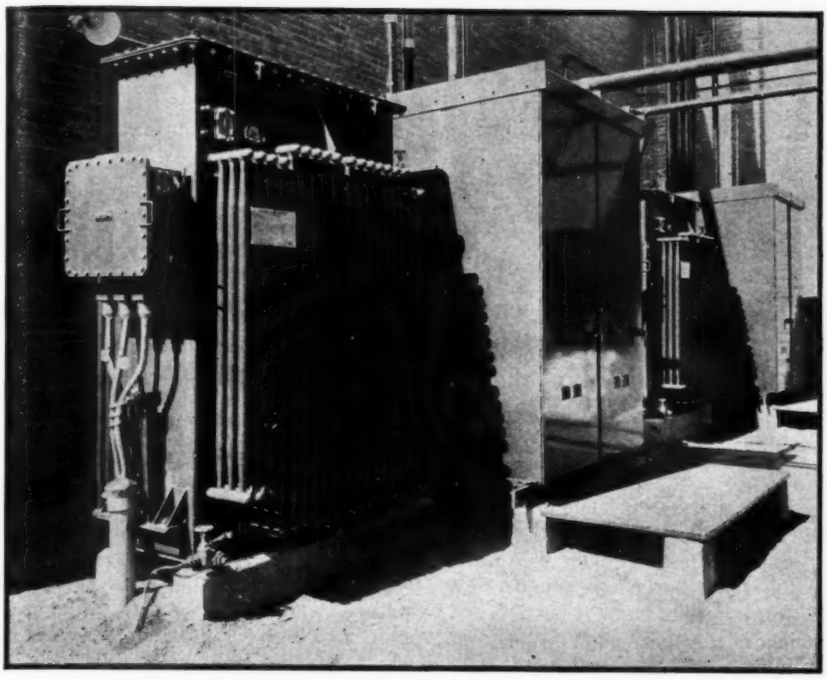
Substation	2500 kva. Conventional	Two 1200 kva. Unit Type
Total Price	$21,071*	$17,870**

* Does not include busses, supports, or steel work.

** Complete ready to install equipment.

In considering the above figures it should be remembered that the short circuit duty likely to be imposed on a circuit breaker on the 1200-kva. secondary bus is only half as much as for a 2500-kva. substation, so smaller breakers could be used on the 1200-kva. substations.

It was estimated that the cost of bus work, supports, and steel work for the conventional substation would be at least $500. Thus two 1200-kva. load-center unit substations would have cost $17,870, while one 2500-kva. conventional substation would have cost $21,571, resulting in a differential of roughly



TWO OUTDOOR UNIT *substations rated at 1000 kva on 3 phase, 60 cycle, 13,200 volts delta to 480 volts delta with drawout low voltage air circuit breakers for transformer and secondary protection. (Figure 2)*

TRANSFORMERS AT TOP OF COLUMNS *through the plant serve groups of fluorescent lighting fixtures from the 480-volt feeder circuits. (Figure 3)*

Transformers

Electrical system equipment for a war production plant uses unit substation and local transformers for fluorescent load.

By J. C. Page
General Electric Company

$3,701 in favor of the unit substation plan in this case. A similar comparison of shipments offered a slight advantage to the unit substation plan.

From these considerations the contractor decided to utilize the unit substation plan. However, a more accurate load check revealed that 2000 kva. of substation capacity would be sufficient. Two outdoor type load-center unit substations were installed as shown in Fig. 2. Each unit substation comprises (1) a three-phase 1000-kva. transformer section with primary junction box and potheads, and (2) a low-voltage feeder section, throat-connected to the transformer section, containing a 1500-ampere main air circuit breaker for transformer time-overcurrent protection and five air circuit breakers for the control and protection of the 480-volt feeders.

The arrangement of the substation yard was novel in that it consisted of a niche in the side of the plant building with a suitable gate and fence to aid in the prevention of sabotage. The substation niche or yard was located at the middle of the 1000-foot side of the building in order to reduce the mean length of the 480-volt feeder runs.

The two unit substations were laid out for straight radial operation because of the greater simplicity and lower secondary short-circuit currents. From the substations, nine 480-volt main feeders consisting of three single-conductor rubber and braid cables were carried through the building walls in steel conduit to serve indoor power and lighting loads, while one 480-volt feeder was run overhead to serve the series street lighting load.

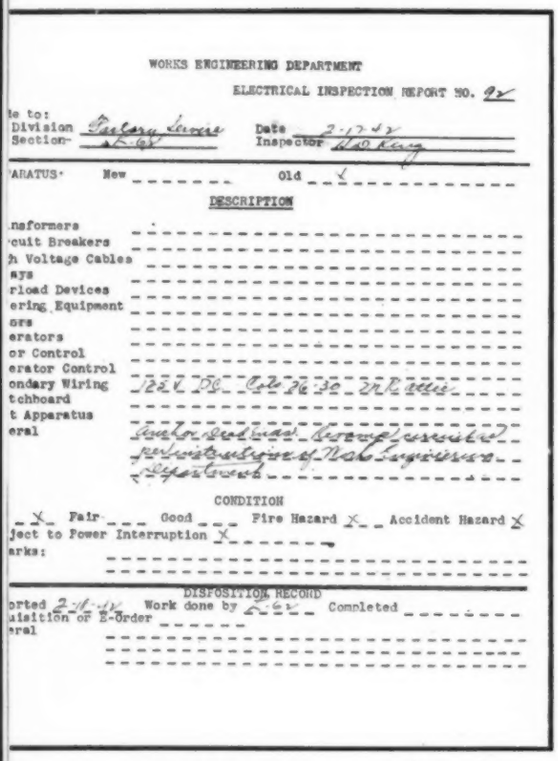
Lighting for night traffic along the roadway was obtained by means of eighteen luminaires, bracket-mounted on the building. These were spaced at intervals of 100 to 150 feet around the building. Lamps of the multiple type rated 300 watts, 120 volts, were used. These were supplied from the indoor lighting supply, but arranged for group control from the gatehouse.

Protective lighting for the factory yard was provided, also arranged for group control from the gatehouse. To accomplish this a 25-kw., 440-volt, 20-ampere, constant-current transformer and protector were arranged to feed a 2500-volt pole line running just inside the fence along the edge of the factory yard. Poles were spaced about 150 feet apart with one luminaire bracket-mounted on each pole. Series type 10,000-lumen lamps were used. These were arranged to illuminate the fence and considerable area beyond the fence. Similar treatment has been given the parking area, with the luminaires served by the constant-current transformer mentioned above.

[Continued on page 99]

Preventive Maintenance

Under wartime schedules, maintenance can no longer be considered an "afterthought"—something to do during a production lull. It is a full-time job of systematically looking ahead of trouble. Here is how one program is organized.



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or Control
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ondary Wiring
tchboard
t Apparatus
eral
Inside bulkhead Group furnished
per instructions of Mr. Engineer
Reported

CONDITION

X Fair ___ Good ___ Fire Hazard X Accident Hazard X
ject to Power Interruption X
arks:

DISPOSITION RECORD

orted 2-17-42 Work done by C.C. Completed _____
uisition or E-Order _____
eral

INSPECTION REPORT *sent to the works engineering department covers practically all types of electrical equipment. Repair recommendations and action follow receipt of this report.*

IN a manufacturing plant the size of Westinghouse at East Pittsburgh, the problem of maintaining existing electrical equipment on an efficient operating standard, detecting defective transformers, turbos, motors, generators, relays or cables before they reach the point of creating a power outage or work stoppage could be a "headache" or simply a routine job. We believe that in our present set-up we've arrived at a method of minimizing lost time in outages and work stoppages by adopting a program of regularly inspecting and cleaning electrical equipment. Where defects have been discovered, or where the operating standards have become questionable, immediate replacements or repairs are made as the case warrants.

Maintenance, in a sense, means keeping the equipment operating. If anything does happen, it is the job of the Maintenance Department to make immediate repairs and get the equipment back into operating condition. Such a process necessarily means considerable loss of time and production. If the maintenance men knew when or where a possible outage may occur, they could have the available spare equipment on hand for immediate repair or replacement before the accident happened.

In January 1939, we adopted a program of preventive maintenance—a regularly scheduled program of cleaning and inspecting practically all electrical equipment. The first six months of the program indicated that the major portion of the equipment inspected was very badly in need of cleaning and repairing. That such equipment should be periodically cleaned and inspected has been borne out by some of the extremely bad conditions which were found and corrected. This prevented a large number of accidents and fires that would have resulted if the program had not been launched. The situation was particularly bad on the oil circuit breakers throughout the plant. We found breakers in practically all divisions with badly burned and pitted contacts, some with insufficient oil and several with the operating mechanism in hazardous condition.

Now, all of our electrical equipment is inspected, cleaned, tested and repaired at regular intervals by the maintenance men of the various divisions. The results of these inspections are reported to the works engineering department where a complete record is maintained at all times.

Shut-downs Are Planned

Even though a definite schedule has been adopted for cleaning and inspecting equipment, a second plan had to be formulated before a circuit, transformer station or feeder could be de-energized for inspection, cleaning or repairing. Previously we had performed most of our inspections on Saturday afternoons or Sunday, when some of our load was at a minimum or entirely off. However, our present day operating load is practically the same for the entire seven days of the week. As our shutdown period must be a minimum, we have set up a schedule whereby all main line lift type power breakers are changed during the day time, usually between the hours of 11:30 to 12:15.

While such a schedule obviously means a minimum of possible work stoppage, a definite procedure is followed so that all parties concerned with the proposed shut-down will be notified. The usual procedure is as follows: Requests for such power shutdowns are made to the production supervisor of the factory service department, who contacts the various shop production supervisors to obtain their permission. Copies of all correspondence pertaining to such power shutdowns are given to the power plant personnel, works electrical engineer, and to the maintenance department.

Breakers Tested and Overhauled

When permission has been obtained to open a particular circuit breaker, the maintenance department is properly notified, the breaker is removed from its housing and a reconditioned one installed. This is part of the preventive maintenance set-up. The breaker is given a thorough mechanical and electrical overhauling to put it in first-class condition. During the changeover, megger readings are taken of the feeder cables to the shop load. If the reading is greater than 1000 volts per megohm we can, with safety, assume that the outgoing feeder circuit is in a satisfactory condition.

If the megger reading is less than 1000 volts per megohm we immediately begin to look for trouble. A second request for a shutdown on the particular feeder circuit is made. In this case, the work is done on Sunday in order to have more time to do the job. When

By
R. G. Edsall
Factory Service Department
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

permission has been granted, the maintenance men open the main feeder breaker and test the feeder from point to point until the defect has been located and repaired. Thus, a serious power outage has been prevented by repairing the damage before the breakdown has occurred. This is not a theory, but an actual tried and proven method. We have followed this procedure in many cases and have saved many hours of work stoppage as well as considerable savings in the cost of valuable electrical equipment by simply repairing the defect before it causes trouble.

Cable Maintenance

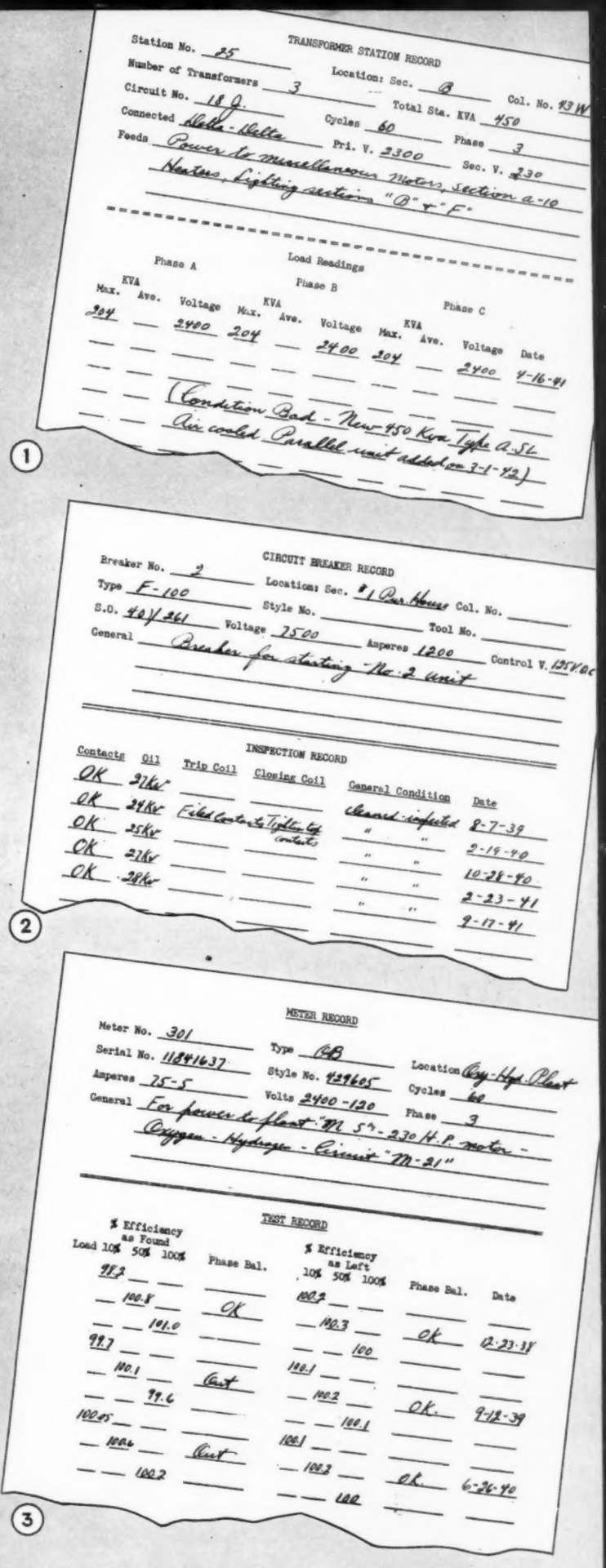
Until recently we had some trouble due to electrolytic action on our lead sheathed power cables which were in underground ducts. Most of our trouble was caused by grounded equipment on the 250-500 volt d.c. system. In order to simplify maintenance on lead cables we permanently installed a recording ammeter in the power house between the neutral cable and an earth plate. Normally we have been able to hold the ground return current as low as 10 amperes. When this current exceeds a fixed figure, our maintenance men isolate the various feeders and locate and repair the offending equipment.

Power Distribution

An ideal scheme of power distribution is the network set-up whereby several units are connected in parallel to serve a particular area or building. Our system is not of this type as it is the outgrowth of an old two-phase, 25 cycle system. When we gradually changed to three-phase, 60 cycles, we simply added a third transformer.

In order to maintain power we have, in most cases, established several transformer banks in parallel, so that the loss

[Continued on page 158]



TRANSFORMER STATION RECORD

Station No. 25 — Location: Sec. B — Col. No. 93 W
Number of Transformers 3 — Total Sta. KVA 450
Circuit No. 18 J — Cycles 60 — Phase 3
Connected Delta-Delta — Pri. V. 2300 — Sec. V. 230
Feeds Power to miscellaneous Motors, section a-10 Heaters, Lighting sections "B" & "F"

Load Readings

Phase A KVA Max.	Phase A KVA Ave.	Phase A Voltage	Phase B KVA Max.	Phase B KVA Ave.	Phase B Voltage	Phase C KVA Max.	Phase C KVA Ave.	Phase C Voltage	Date
204	—	2400	204	—	2400	204	—	2400	4-16-41
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	(Condition Bad - New 450 Kva Type A-5L							
—	—	Air cooled Parallel unit added on 3-1-42)							

1

CIRCUIT BREAKER RECORD

Breaker No. 2 — Location: Sec. #1 Pur House — Col. No.
Type F-100 — Style No. — Tool No.
S.O. 40/261 — Voltage 7500 — Amperes 1200 — Control V. 125 V.D.C.
General Breaker for starting No. 2 unit

INSPECTION RECORD

Contacts	Oil	Trip Coil	Closing Coil	General Condition	Date
OK	27Kv			Cleaned-inspected	8-7-39
OK	24Kv	Filed Contacts Tightened contacts		" "	2-19-40
OK	25Kv			" "	10-28-40
OK	27Kv			" "	2-23-41
OK	28Kv			" "	9-17-41

2

METER RECORD

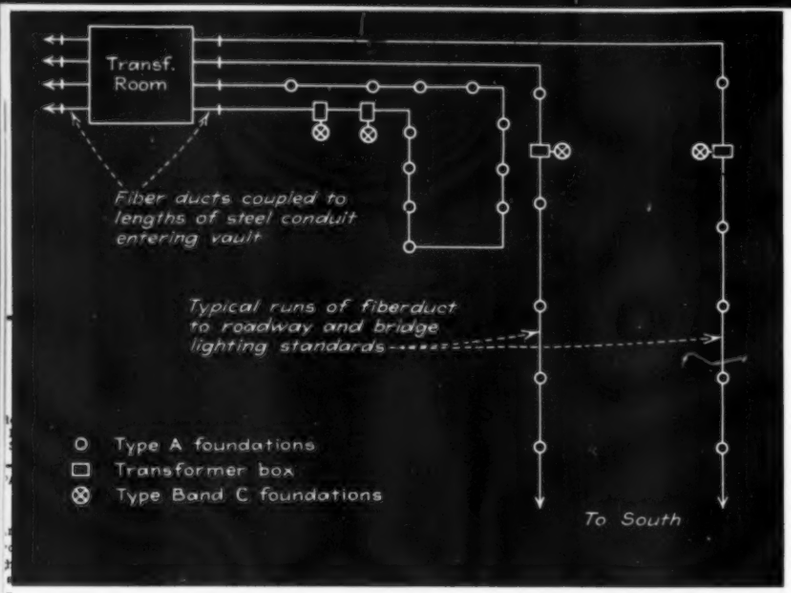
Meter No. 301 — Type GB — Location Oxy-Hyd. Plant
Serial No. 11841637 — Style No. 429605 — Cycles 60
Amperes 75-5 — Volts 2400-120 — Phase 3
General For power to plant "M" 5th - 230 H.P. motor - Oxygen - Hydrogen - Circuit "M-21"

TEST RECORD

% Efficiency as Found Load 10%	50%	100%	Phase Bal.	% Efficiency as Left 10%	50%	100%	Phase Bal.	Date
98.2	—	—	—	100.2	—	—	—	—
—	100.8	—	OK	—	102.3	—	OK	12-23-39
—	—	101.0	—	—	—	100	—	—
99.7	—	—	—	100.1	—	—	—	—
—	100.1	—	Out	—	100.2	—	OK.	9-12-39
—	—	99.6	—	—	—	100.1	—	—
100.05	—	—	—	100.1	—	—	—	—
—	100.4	—	Out	—	100.3	—	Ok.	6-26-40
—	—	100.2	—	—	—	100	—	—

3

MAINTENANCE RECORDS tell the story. A representative group include: (1) transformer station; (2) circuit breaker; (3) meter record. Comparison of filed records indicate the condition of the system. Weak points can be remedied before trouble occurs.


Transf. Room
Fiber ducts coupled to lengths of steel conduit entering vault
Typical runs of fiberduct to roadway and bridge lighting standards
Type A foundations
Transformer box
Type Band C foundations
To South

FIBERDUCT RUNS *extend under roadway and sidewalks north and south of the main transformer vault.*

UNDERGROUND

Fibre conduits, lamp standard foundations and complex working schedules were features of this West Coast lighting project.

By Henry W. Young

WHAT is known as the Front Avenue Improvement in Portland, Ore., is a $4,000,000 project of the Oregon State Highway Commission. The major features of this work were started before the present stringent restrictions as to materials. Coming in the category of being essential to defense transportation, these portions are going forward to completion under a P-19-A form with A-4 rating.

A rather intricate system of underground ducts and metal conduit is required to accommodate the wiring for street lighting units and for traffic signals. Typical of the underground work is the sub-contract of the Ne Page Electric Co., Seattle, Wash., handled through its Portland office, W. D. Paulson, manager.

The Ne Page contract calls for conduit, both fibre duct type and metallic, for the street lighting and traffic signal systems. It also includes construction of the concrete foundations for lamp standards and for transformer boxes, including also all breaking up of old pavement and sidewalks where necessary to install the conduit, all excavation and all attendant concrete work. The contractor, of course, employed men of other trades to do this diversified work, but it was under his supervision. No wiring is included in the contract.

The work has been going on for months and under adverse weather conditions, including mud and frost. It has also had to be carried along in step with the progress of the general contract, including building wreckage, bridge approach building, general excavation, grading and paving. So, for the electrical contractor it has been a case of doing a bit here and a hitch there where he had the opportunity to work without holding up the general progress, and then going back over it again and again to join the pieces together.

Two types of conduit are installed:

(1) For ornamental street lighting standards, Nocrete, 2-in. Construction includes concrete bases complete with foundation bolts for the standards.

(2) For traffic signals, galvanized conduit, ¾-in. to 3-in.

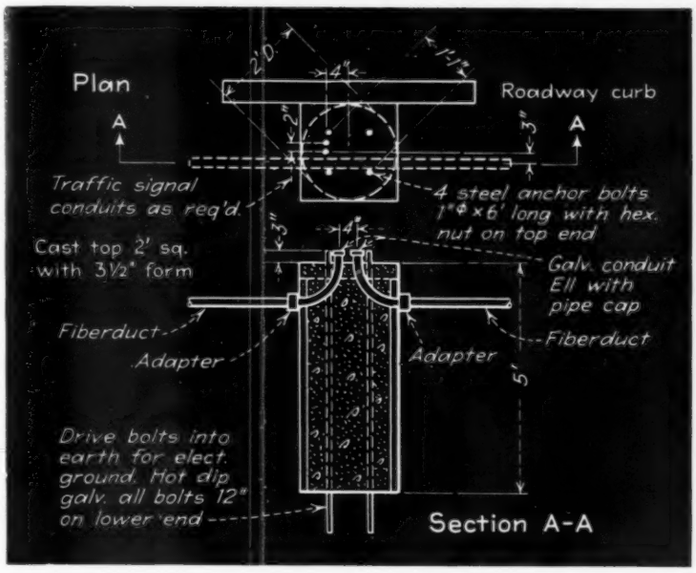
The main run of Nocrete passes 18 inches under the present sidewalk surface. It was necessary to do this in order to leave the entire street width in the clear in case it became necessary to tear out curbing in the course of the new paving work. To chip out the concrete walks and dig the trench 18 inches deep by a foot wide was merely a time consuming job. But dodging manholes and water mains, through short tunneling operations, was more intricate. When basements extended under sidewalks, it was necessary at points to swing clear to the curb.

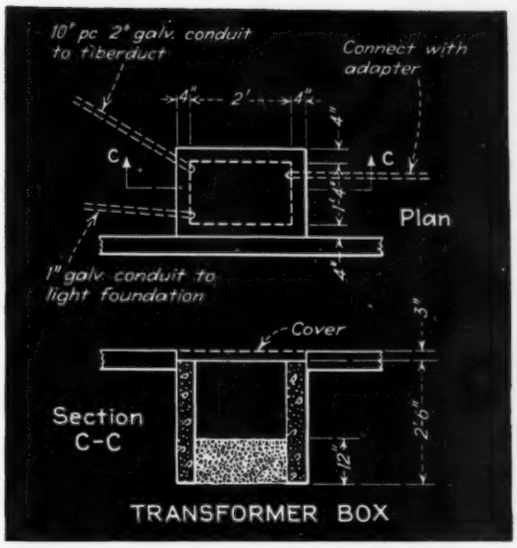
The main street-lighting circuit, from an underground vault, will pass through 3-in. metal conduit to a new transformer room. All conduits to the transformer house are stubbed under the retaining walls. Galvanized conduit at least 10 ft. long and including any adjacent bends terminate all runs of Nocrete duct at the transfer room.

WOOD TEMPLATES *insured vertical anchor bolts, providing rigid and accurate location during the pour. (Below)*

MINIATURE CAISSON *holds back flowing mud at foundations. W. D. Paulson holds the bail by which it is drawn up. (Right)*

HIGHWAY DUCTS





TRANSFORMER *boxes are located near type B and C foundations. Fiber duct runs through and short conduit stubs extend to light standard foundation. (Above)*

FOUNDATION *for type "A" light standard illustrates method of terminating conduits for a through run. (Left)*

Traffic signal circuits are run in galvanized pipe from the underground vaults of the power company at each street intersection. The parked areas are also to have lawn sprinkler systems, the turning on and off of which is to be eventually done by remote control. Providing the necessary conduit for the system is part of the contract and is being done at this time.

There are three types of bases for lamp standards being constructed by the Ne Page Electric Co. The "A" base, which is 2-ft. in diameter by 5-ft. deep, has the galvanized anchor rods for the standard driven into the ground for 12-in. to provide an electrical ground. These rods are 1-in. in diameter, with hex nut on the top end. Galvanized pipe ells are embedded in the concrete at the top, coming out at the sides where they meet the Nocrete duct.

Type "B" and "C" are similar to each other except that "B" is smaller, being 6-ft. deep by 2-ft. in diameter as against 7-ft. by 3-ft. for "C". In each, the anchor bolts are wholly embedded in the concrete and have hooked lower ends. In all types, the conduits are required to be stubbed in the base and capped for future wiring.

Steel poles to be erected on the Type "A" bases will include space for an isolating transformer in a cast steel housing attached to the base. The poles to be erected on the Types "B" and "C" bases will be of heavier construction and will not include such steel housings. Concrete boxes for this purpose are being constructed adjacent to these bases by the contractor. These boxes are detailed on the drawing as a Type "A" transformer box and are to be fitted with cast concrete covers, allowing three-sixteenths of an inch all around for seal. A 1-inch metal conduit provides for electrical connection between the pole base and the transformer box.

In the construction of the bases, the electrical contractor ran into some of the problems encountered in concrete construction work and solved them in his own way. For instance, some of the excavations had to be made under conditions where it was impossible to dig without having the hole fill up with flowing mud. He got around this by making a kind of cylindrical, bottomless "pail" with heavy bail attached. This was pushed down as the excavation progressed, the material being removed from the bottom with a pole hole spoon. When the excavation was completed to the necessary depth, concrete was poured and compacted a short distance, the "caisson" pulled up that amount and more concrete poured immediately. In this manner, it was possible to pull up the device without too much effort and concrete was left up against the sides of a smooth, cylindrical hole.

One item of cost is avoided on this job and that is as regards cradling. There is none. The duct is practically all laid on the ground in the bottom of the trench, the runs being single. The runs are simply well cushioned with sand or fine material such as clean dirt, free of stones, care being exercised to see that all parts of the duct rest on soil.

Ready-mix concrete was used on all the concrete work, delivered to the site of each foundation, or so close as to require little wheeling.

CONCEALED DUCT *ends are marked for easy pick up by streaks of paint.*

SHAFT PREPARATION, *the first step in the process, involves grooving the worn section and burring and peening the groove ridges with a special rotary preparation tool.*

Shaft Build-Up By METALLIZING

Metallizing provides an added tool to the motor repair shop and makes possible speedy shop build-up of worn shafts and bearing surfaces. Here's how it is done.

By D. A. Watson *Metallizing Engineering Co., Inc. Long Island City, N. Y.*

METAL SPRAY *is applied to the prepared sections of the shaft as the second step. Shaft is rotated in the lathe; spray gun is held in hand.*

TODAY, metals and equipment are scarce. Time is at a premium. And motor service shops must make speedy repairs under these unusual handicaps. In the past, worn motor shafts and bearing surfaces frequently had to be built up in outside machine shops. Now, motor service men can do this themselves.

This is possible through metallizing, a simple, speedy process of spraying molten metal on the worn surfaces. The main prerequisites, excepting the spray gun and auxiliary tools, are acetylene, oxygen, compressed air and a lathe, all conventional shop equipment items.

The metallizing gun consists of a small five-pound hand or lathe tool through which metal wire is automatically drawn at a predetermined speed. This varies from 2-ft. to 13-ft. per minute, depending on the type of metal used. At the "gun" nose the wire is melted in an oxygen-acetylene flame, atomized into fine particles by a high velocity jet of compressed air and projected on the surface to be built up. One important feature of this process is that the metal particles do not carry enough heat, at the time of impact, to cause warpage or crystallization of the base metal. The entire process involves three basic steps.

1. Surface Preparation

The surface to be built-up must be carefully prepared. Upon this depends the bond between the sprayed and base metals. The preparatory methods fall into three groups.

A. *Grit Blasting*—with angular sand or steel grit, although used on large flat surfaces, has now been almost eliminated for shaft work. This method required expensive equipment and gives a bond strength too low for usual shaft stresses.

B. *Rough Threading*—of the shaft gives a greater bond strength at much lower cost, and has proved successful on cold rolled shafting. A rough thread is torn on the shaft by setting a threading tool below the shaft center.

C. *Barbed Grooving*—is the latest method developed for alloyed metals. Round bottom threads or grooves, generally 16 to the inch and .025-in. deep are cut on the shaft with an ordinary tool bit ground .045-in. wide. A special rotary shaft preparing tool in the lathe tool post is run back and forth over the

[Continued on Page 157]

FINISH MACHINING *or grinding completes the process. The excess metal is removed and the built-up "humps" reduced to regular shaft size.*

An abstract of a paper presented at the Ninth Annual NISA Convention in Cincinnati.

Right off the *Top*, boys *and plenty* *Dirty!*

Getting stores from the top of the heap is always a dirty job . . . for dust settles on horizontal surfaces everywhere whether these surfaces are boxes in storage or parts inside motor control in any factory.

Cutler-Hammer *Vertical* Contacts are the mark of better Motor Control, another extra dividend on Cutler-Hammer's unequalled specialized experience and decades of leadership.

More and more engineers are recognizing the hazard of dust in Motor Control. That fact is proven by another fact . . . that more and more engineers responsible for non-stop victory production are *insisting* on Cutler-Hammer Motor Control. It's the Motor Control with the famous *dust safe* VERTICAL contacts that can't collect dust, that *stay* clean to last longer and work better. Dirty electrical contacts can sabotage production just as surely as any "underground" organization, and a great deal more insidiously. Play safe. Specify Cutler-Hammer Motor Control and *see the difference.* CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

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CUTLER-HAMMER
MOTOR CONTROL
C-H

Dust Safe
VERTICAL
Contacts

1892-1942 50th ANNIVERSARY

under thousands of
"heavy traffic" streets like this

ORANGEBURG CONDUITS

are contributing to continuity of service by providing complete and lasting cable protection

For example, the Ne Page Electric Company of Seattle, Washington is now completing the installation of *more than a carload* of Orangeburg NOCRETE for the Front Avenue Improvement Project in Portland, Oregon.

Today, *as never before*, the safest place for cable—whether it be for power, lighting, fire, telephone, or signal service—is underground . . . *in Orangeburg Conduits.*

ORANGEBURG ***Standard*** for installation *with* concrete encasement
NOCRETE for installation *without* concrete encasement

Photograph by Nesmith

ORANGEBURG HAS BEEN A LASTING NAME "UNDERGROUND" FOR 49 LONG YEARS

THERE ARE EXTRA PROFITS FOR YOU IN EVERY *"time-and-material-saving"* FOOT OF

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7-FC-4

CONVERSION LIGHTING

Every day that the war is shortened means the saving of lives of our fighting men and the hastening of the time when hundreds of thousands of people can face the morning without soul destroying fear. We must not waste those days.

Nor shall we if we quickly convert to war work the needed thousands of factories that have been supplying less essential civilian needs. Yet, before most of those shops can turn out the components of the tools of war, they must be relighted, so that the human beings who man the machines can devote their finest skill, experience and ingenuity to their individual tasks.

Lighting does not have to be sold to those in charge of the war production efforts. WPB wants these converted plants to have efficient light. But it wants to be sure that the light asked for is needed, that it is adequate, that it does not use more critical material than is necessary.

For that reason, WPB requires certain information before it will assign a preference rating. The following section is a simple, practical exposition of what is desired and why, fortified with a group of case studies covering a wide range of lighting applications and chosen to show the factors that WPB analysts must consider in rating applications.

While this manual of priority procedure for conversion lighting does not carry official endorsement, the material herein has been prepared with the full cooperation and review of the Lighting & Fixtures Section, WPB.

Electrical Contracting and Electrical World have prepared this manual to help get the job of conversion done more quickly, to accelerate war production and to speed a victorious peace.

A Manual of Priority Procedure

HOW LIGHTING RATINGS ARE HANDLED

WPB SECTION WILL RECOMMEND PREFERENCE RATINGS FOR INCREASED LIGHTING FOR WAR WORK IN CONVERTED FACTORIES UPON SUBMISSION OF FULL INFORMATION PROVING THAT MOST LIGHTING BENEFIT IS PROVIDED WITH LEAST MATERIALS.

BY MARSHALL N. WATERMAN *Chief, Lighting and Fixtures Section of Building Materials Branch, WPB.*

CONVERSION OF INDUSTRIAL PLANTS from peacetime pursuits to the production of the weapons for waging total war is the biggest job ever undertaken in the United States in so short a period of time. We are taking this conversion route because it is the quickest way to get the necessary increase in production of war material and win the war, and because it involves, also, the least drain upon the raw materials which are better used to turn out guns and shells, tanks and planes. Steel used to build new war factories while civilian plants stand in enforced idleness is steel which cannot also go into making tanks, yet tank parts can well be made in converted shops.

Sometimes conversion is a relatively simple operation so far as gearing the working facilities to the war job is concerned. More often, the job is almost as complex as equipping a new plant. But practically always there is a lighting problem involved in plant conversion—the problem of providing the lighting essential to produce the maximum efficiency and the minimum waste. Getting good lighting means arranging for more lighting in almost every instance, and usually not just a few foot-candles more. Rather, it often means a major increase in light intensity.

This is true because war jobs are more precise jobs, demanding closer tolerances and swifter, surer assemblies. The weapons of war must be built to withstand the terrific strains of the battlefield, and it is axiomatic in the armed services that the side with both superior quality and quantity of weapons always wins!

But it isn't only the difference in the work which requires more lighting. Another frequent reason is the need for keeping the job going around the clock in a plant never intended to be so operated. This means a great deal more overtime work, with attendant increased eye-strain. And as the Army and Navy take more and more young men, increased lighting will be required to serve the growing proportion of older workers.

We, in the Lighting and Fixtures Section, realize these things. The Section is part of the Building Materials Branch headed by Mr. J. L. Haynes, which in turn is a part of the Division of Industry Operations, War Production Board, the agency directing the war production program. It is our job to see that American industry, in converting its facilities to war work, is able to obtain the better lighting that it requires.

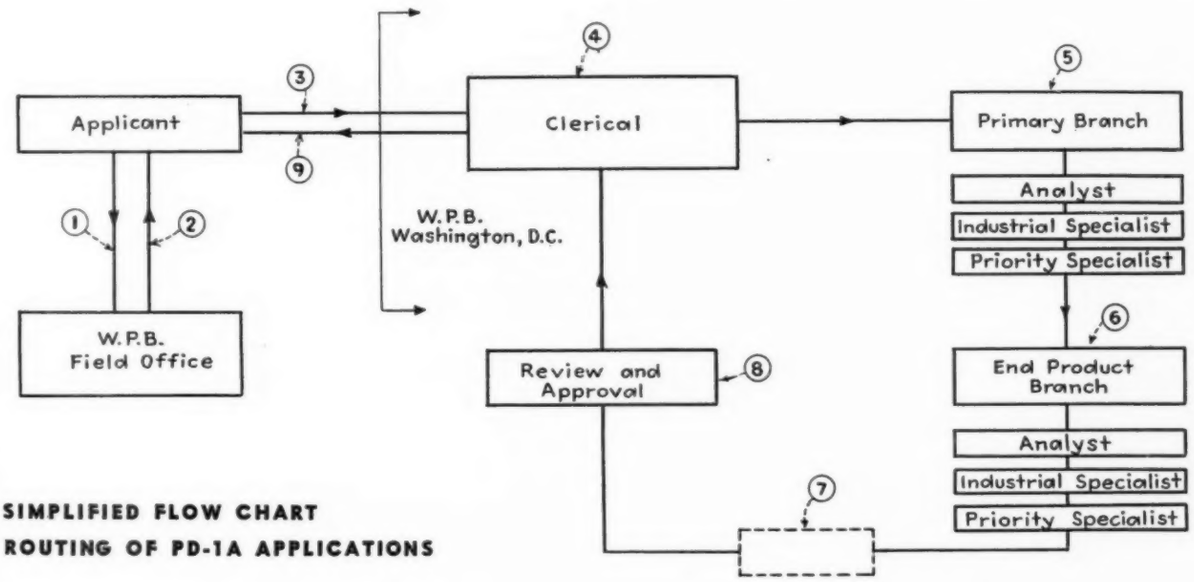
But it is also our job as a part of the WPB to see to it that whatever scarce materials which must be used for plant lighting are made to give full value, and the materials required for lighting are among the scarcest—copper, for instance! Just as the WPB as an overall policy is taking the conversion road to conserve materials for the production lines so, too, must we conserve essential war materials by making sure that what is used for lighting brings the maximum yield in improved illumination.

CONVERSION LIGHTING

In carrying out this job we recognize what every good lighting engineer knows—that good lighting means increased production, better workmanship, reduction in accidents, etc. We know, also, that the recognized standards of the lighting industry as represented by A.S.A. recommendation are an excellent guide for production lighting. Also, we realize that the various types of lamps have their parts to play, that sometimes substitution of fluorescent for incandescent will give a significant improvement in illumination without requiring an excessive amount of critical wiring materials and additional power resources. Always bearing in mind that there is no general answer and that each job must be analyzed individually.

The Lighting and Fixtures Section is prepared, in proper instances within the overall priorities structure, to recommend adequate preference ratings for needed equipment of accepted types for improving plant lighting, where this improvement is shown to be for war production work and the proposed lighting design conserves new materials. But if we are to decide wisely we must have the cooperation of those who design and install the new lighting installations. To pass judgment properly upon a proposed relighting job we must have full and detailed information of what changes are proposed and why.

There is nothing complicated about the information we require. It is, essentially, the same information that lighting engineers should themselves require in designing the job. What is it we



SIMPLIFIED FLOW CHART
ROUTING OF PD-1A APPLICATIONS

1. Request for PD-1A application forms—in person or by mail. (Field office directory attached).
2. Receipt of application.
3. Filing of PD-1A application and *supplementary data* with Director of Industry Operations (PD-1A) Washington, D. C.
4. *Incoming (and outgoing) mail sorted, cased, routed, issued, filed, etc.
5. Primary Branch—responsible for industrial plant or establishment in which it is proposed to install new lighting. Recommends importance of plant to war effort.
6. End Product Branch—responsible for products (example—Lighting Fixtures End Product Branch—Lighting Fixtures Section) and manufacturing problems related to those products. Recommends rating that should be assigned. Strips application of unessential material, analyzes, etc.
7. Third Branch—if required such as materials branch copper, aluminum, etc., if required.
8. Final Review.
9. Application and/or letter returned to applicant. a. Approved with rating, b. Denied, c. Requesting more complete information. If c, routing repeats as with new application.

*Certain purely WPB internal operations here and elsewhere in WPB omitted.

want to know? Well, what type of work is to be performed in the area to be lighted? Don't simply say "airplane parts manufacturing"—say: "Precision machine work on airplane parts." Tell us the square footage, the ceiling heights, the condition and color of the walls and ceilings. Detail the existing fixtures and give us the present light intensity. If it is a big job—any one involving more than 100 fixtures—prepare a schematic wiring diagram, but in any event explain whether existing wiring can be used and if not what new wiring is required.

These are some of the things to tell us about, always in detail. A complete list of required information has been prepared for use in making lighting applications for priorities and it is more fully discussed elsewhere in this supplement. It should be noted that this data all must be supplied in addition to the standard information required on the rating forms.

With all this information, what we do is develop the same data that would be provided by a field survey. Lighting applications arriving at WPB are first routed to the branch handling the product which the plant is being converted to turn out—that is, a gun plant lighting application goes to the Ordnance Branch. There the plant conversion job is graded in its relationship with the war effort by the group best acquainted with the manufacturing job involved, and the need for the product made. Then, the application comes to us.

If it is a relatively simple job it goes to a staff analyst for a rating based upon the plant conversion grading, without a detailed lighting engineering study. Other applications go to a lighting specialist who calculates the present lighting values against the proposed values, in accordance with standard formulas. He considers the proposed light distribution and intensity for the kind of work described. He estimates the weights of materials involved as a means of determining the cost in materials of the increased illumination. Finally, he may recommend granting an adequate rating, suggest modification of the design to reduce the use of materials without materially reducing the lighting to be provided, or recommend rejection of the application entirely.

Whether the application goes to the analyst or to the specialist, however, the length of time it takes to get a decision depends largely upon the care with which the applicant has supplied the necessary information. Poorly or inadequately prepared applications simply pile up awaiting further data while properly prepared requests for priority help are given the right-of-way.

Just a few words to summarize what I have said. As a nation we are converting our industrial production to war production to speed output and save scarce materials. To do the job cut out for them most plants need more lighting. The Lighting and Fixtures Section is prepared to recommend ratings for increased lighting for war work where such re-design provides the most lighting benefit for the amount of scarce materials required. To make sure that materials are being conserved, the Section requires certain detailed information in excess of that asked for on the standard rating application blank. Finally and above all, applications which come to us with all the required information will get a prompt decision; others are simply losing time, generating useless work and delaying war output.

• • •

The PD-1A form is in use as we go to press for conversion lighting application. It should be noted, however, that the use of particular rating application forms such as PD-1A are subject to frequent changes in the complex priorities structure. (Ed.)

PROCEDURE TO FOLLOW

1 . . . Data on existing and proposed lighting is compiled and submitted to owner.
2 . . . Owner submits war pattern information with complete lighting data on PD-1A to WPB, priorities division.
3 . . . Rating is denied or assigned on PD-1A and returned to owner with serial number.
4 . . . Owner extends rating to supplier with purchase order for equipment.

APPROVALS ARE EXPEDITED BY

1 . . . Full PD-1A data and complete lighting data, submitted with original application.
2 . . . High ranking war pattern indicating important war connected production.
3 . . . Urgency of requirements as indicated by substandard existing lighting and night schedules.
4 . . . Compliance with accepted standards of lighting design in new system layout.

DENIALS OR DELAYS ARE CAUSED BY

1 . . Inadequate information concerning war pattern or inadequate data for analyzing the proposed lighting installation.
2 . . . Excessive requirements in critical materials for lighting equipment, wiring or power resources.
3 . . Lack of essential need where existing lighting equipment is reasonably adequate for the kind of work performed or where local lighting could readily provide the necessary improvement.
4 . . Inadequate lighting design when the proposed system offers no significant improvement over the existing lighting installation.

DATA DEFICIENCY SLOWS RATINGS

CONVERSION LIGHTING

APPLICANTS USING PD-1A FORMS for obtaining a preference rating on conversion lighting installations are accustomed to the type of information required on all requests for a rating to obtain capital equipment. Lighting installations for proper analysis and rating however, require detailed information beyond the scope of that requested in the standard form. The additional information which should accompany application is given on a succeeding page. The following examples show how information is received by the Lighting and Fixtures Section and how defects in the data provided slows the machinery of rating assignment.

Example "A"—An automobile parts manufacturer converting to the manufacture of landing gear parts for bombers provided full information as requested in the instructions to PD-1A, but simply stated that existing incandescent fixtures would be replaced with fluorescent equipment.

Upon receipt of this request the Section analyzer sent back a supplementary questionnaire. The applicant through information provided by the company handling the lighting installation, returned the details of the lighting installation necessary for the guidance of the analyst and was promptly assigned a rating.

Comment—Submission of the data needed for job analysis with the original application would have permitted analysts to issue a rating nine days sooner.

Example "B"—Converting a small appliance plant to the manufacturing of small sirens, the applicant stated that he was "obtaining army and navy orders" but did not give his war pattern or status of existing orders. The rating which he requested to obtain fluorescent lighting fixtures was held up pending more information. At the same time he was asked to provide data on the proposed installation. His existing incandescent lighting was estimated at 5 foot-candles, too low for the type of work contemplated. The data on the proposed installation showed an anticipated intensity of 40 foot-candles. Estimates by conventional formulas showed, however, that the new installation could not provide more than 7.5 foot-candles.

The application was returned with the conditions noted and a suggestion that competent technical assistance be obtained. A later request revised to include 200-watt fluorescent industrial units and estimated to provide 24 foot-candles was received with complete data and a classification of the war pattern. A rating was eventually assigned.

Comment—Submission of exact war pattern with original PD-1A would have cleared the request for analysis. Details of a proposed lighting installation based upon sound engineering practice in layout, design and selection of equipment would have permitted immediate action and rating without delay.

Example "C"—An applicant requested priority assistance for obtaining a new fluorescent lighting installation to provide 20 foot-candles in an office space. A government department was taking over the area, which indicated a good war pattern for the job. The work, however, required a comparatively large amount of new wiring materials and the applicant provided only a statement of "approximately 1 to 3 foot-candles lighting from the existing system." A recommendation for rating was withheld until the existing lighting system could be described in greater detail.

The answer brought out the complete data. The space had been occupied by a restaurant which used only a small number of decorative lighting fixtures, explaining the low intensity from the existing equipment and the amount of rewiring necessary. A rating was assigned at once.

Comment—Full data on the existing system explaining the need and providing a measure of the lighting improvement required should have been submitted with the original application. Here the war pattern was good and the request reasonable but only further correspondence brought out the fact that it was essential.

Example "D"—A manufacturing plant involved in important sub-contract work on tank parts requested a rating to obtain new fluorescent lighting equipment in a drafting room. The precise workmanship necessary indicated that a relatively high order of illumination was desirable and the system proposed would provide 54 foot-candles. An existing incandescent lighting system consisting of semi-indirect units of a modern type, however, provided a measured intensity of 45 foot-candles. Upon analysis the rating was denied and the application returned.

Comment—Again the applicant failed to show an essential need. The "war pattern" was good, the request was reasonable in that the system proposed was appropriate for the type of work involved. However, the proposed system was not a sufficient improvement in illumination to warrant the use of the critical materials involved.

INFORMATION REQUIRED FOR PREFERENCE RATINGS

CONVERSION LIGHTING installations are considered for preference rating as additions to capital equipment. While some lighting equipment can still be obtained without a high rating, fluorescent equipment requires a rating under recent orders of A2 or higher.

The procedure followed at the present time is: (a) the owner applies for the rating to the War Production Board on proper form; (b) after analysis WPB either denies the application or issues a rating high enough to obtain the fixtures when required.

Under this procedure, the applicant must provide all the information required by the rating form and, in addition, specific data about the lighting system proposed. The following questions which appear on the instructions for filing a PD-1A should be prepared by the owner of the plant in which the lighting equipment is to be installed. The additional group of questions on the opposite page pertain only to lighting installations and should be answered by the owner with the assistance, if required, of the engineer or contractor in charge of the proposed work.

PD-IA QUESTIONS

1. Describe product to be produced by you from the material (or capital equipment) for which application is made.
2. Explain use of product to be produced and relationship to War Program, National Welfare, or Government-Sponsored Programs.
3. If you have pending PD-1A application(s) for other material (or capital equipment) required to fill the need for which this application is made, list for each such application (a) description of material (or capital equipment), (b) Date of Application.

4a. If you are operating under any Preference Rating Order(s), "P" Series, applicable to the product with respect to which this application is made, state order number(s) and Serial Number(s).

b. If not, have you made application for any such Preference Rating Order(s) "P" Series? (Identify.)

c. If you are operating under, or have applied for any such Preference Rating Order(s), "P" Series, explain why present application is made.

5. If material (or capital equipment) is required for a single Government contract or a single civilian order for the product, state:

a. Name of Government agency or civilian customer.
b. Supply Arm or Bureau (if Government agency).
c. Complete Contract Number (if Government agency) or Purchase Order Number (if civilian).
d. Quantity of product on contract or on purchase order.
e. Grade of preference rating (if any) assigned to product or contract or on purchase order.
f. If material (or capital equipment) requested or product to be manufactured is destined for shipment outside the continental United States, answer 5a through 5e in full detail including full name and address of customer.

6. If material (or capital equipment) is required for several Government contracts or several civilian purchase orders for the product, state:

a. Names of all Government agencies whose contracts are held.
b. Names of principal civilian customers whose purchase orders are held.
c. Grade(s) of Preference Rating (if any) assigned to product on contract(s) or on purchase order(s).
d. If material (or capital equipment) requested or product to be manufactured is destined for shipment outside the continental United States, answer 6a through 6c in full detail including full name and address of customers.

7. State with respect to each item for which Preference Rating is requested:

a. The shipping date(s) promised by supplier in the absence of a Preference Rating.
b. Names of suppliers (if any) who have refused to accept applicant's order.

8a. State the following with respect to the department in which capital equipment is to be used for 1st Shift 2d Shift 3d Shift
1. Number of men
2. Average weekly hours worked

b. 1. What is the approximate value of the average total monthly output of the department referred to in 8a (based on the quarter immediately preceding the date of this application)?
2. Approximately what percentage of average total monthly output was sold under A-1-a through A-1-c; A-1-d through A-1-j; A-2 through A-10?

c. Do you have in use any equipment similar to that for which application is made?
d. If so, what is the average weekly hours of use of equipment referred to in 8c?
e. How do you now accomplish the work for which you require the equipment applied for?

CONVERSION LIGHTING

ANALYSTS WHO DETERMINE the justification for the new installation under rigid regulations to save the national stockpile of essential war materials need full information. The data should include a clear description of the existing lighting equipment and the proposed new installation together with as much pertinent data as can be provided.

If complete information is not furnished with the application it must be sought by the analyst through correspondence. The consequent delay shows up the heavily burdened government department and holds up the job. The quickest way to obtain a rating for conversion lighting is to provide full information in detail with the application. The additional information desired which pertains to lighting only follows.

Data Supplementing Application Form Required for Prompt Analysis of Conversion Lighting Rating Requests

A. Description of Area (If more than one area, all data should be provided for each separate area)

1. *Physical Characteristics.*
   (a) Dimensions: Width . . . ft. Length . . . ft. Area . . . sq. ft. . . .
   (b) Ceiling Heights . . . ft.
   (c) Reflection Factor (1) Ceiling (light, medium, dark) (2) Side Walls (light, medium, dark)
2. *Type of Work Performed (Required only if not clear in Rating Application).*
3. *Types of machines and equipment used.*
4. *Degree of Precision of Workmanship Required.*
   (a) Rough . . . (b) Medium . . . (c) Fine . . . (d) Extra Fine . . .
5. *Electrical System.*
   (a) Type (alternating or direct current)
   (b) Description—phases, wires, voltage, frequency
   (c) Energy—(purchased or generated)
   (d) Connected load in kw. Light and Power separately
   (e) Maximum demand in kw. Light and Power separately
6. *Branch Circuit Wiring.*
   (a) Number of branch circuits
   (b) Size wire and conduit
   (c) If other wiring methods, describe
   (d) Lengths of runs
   (e) Service entrance voltage
   (f) Voltage at socket

B. Existing Lighting Conditions

1. Type of lighting (direct, semi-direct, semi-indirect or indirect)
2. Light source (incandescent, fluorescent, mercury vapor or other)
3. Description of luminaire
   (a) Manufacturer and catalog number. Other description
4. Number of luminaires
5. Number of lamps per luminaire, lamp rating in watts, rated voltage and type designation
6. Metal used in luminaire—aluminum, copper, steel, other in pounds
7. Mounting height (floor to bottom of luminaire) in feet
8. Spacing of luminaires in feet.
9. Present cleaning and maintenance schedule—describe
10. Present foot-candles on working plane (state whether measured or estimated.)

C. Proposed New Lighting Installation

1. Type of lighting (direct, semi-direct, semi-indirect or indirect)
2. Light source (incandescent, fluorescent, mercury vapor or other)
3. Description of luminaire
   (a) Manufacturer and catalog number. Other description
4. Number of luminaires
5. Number of lamps per luminaire, lamp rating in watts, rated voltage and type designation
6. Metal used in luminaire—aluminum, copper, steel, other in pounds
7. Mounting height (floor to bottom of luminaire) in feet.
8. Spacing of luminaires in feet
9. Anticipated foot-candles

D. Wiring Changes Required

What additional wiring materials, if any, will be required if new incandescent lighting fixtures are used to replace existing lighting fixtures?

E. Other Pertinent Data

1. Can existing fixtures be repaired and re-utilized? If answer is no, what use will be made of existing fixtures?
2. Will the installation of additional lighting fixtures to supplement the existing lighting installation produce satisfactory lighting? If so, what additional material will be required to accomplish this?
3. Can a form of supplementary lighting be used to achieve desired results? If so, what additional materials will be required to accomplish this?

FLUORESCENT LIGHTING IN AN ORDNANCE PLANT

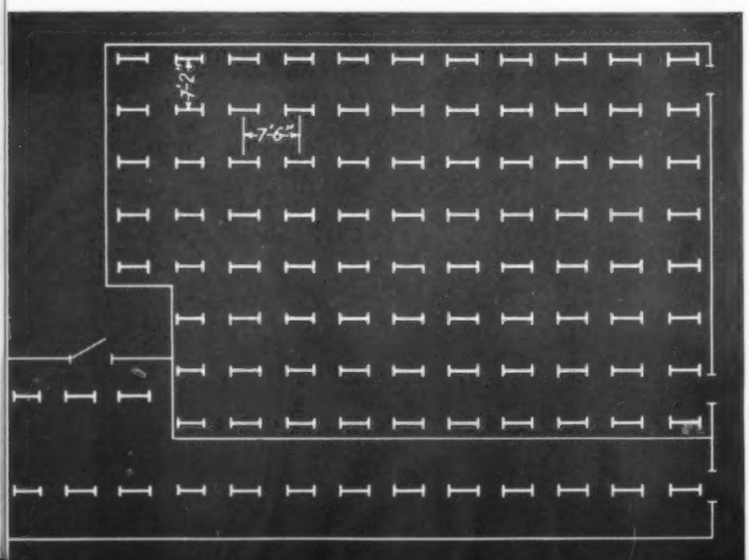
IMPROVED GENERAL ILLUMINATION OF 20 TO 35 FT-C WITH FLUORESCENT UNITS IN MULTI-BUILDING PLANT.

DESCRIPTION OF AREA. The application for priority assistance was made by an agricultural machinery manufacturer during a conversion program. Large areas of the plant which consisted of a number of buildings were converted over a period of several months. Conditions of ceiling and side walls varied through the plant and in general were classified as dark.

EXISTING LIGHTING. The old lighting was inadequate for night shift operation and the closer tolerances in machine work under the new production requirements indicated an urgent need for improved illumination.

PROPOSED INSTALLATION. It was proposed to install 1000 fluorescent industrial lighting fixtures with 2 40-watt fluorescent white lamps for general lighting through a large portion of the plant. In each area the lighting intensity was designed to fit the specific production needs by varying the spacing of the fixture as follows:

Area "A", ordnance assembly—7-ft. 6-in. by 7-ft. 2-in. Area "B", forging—9-ft. 6-in. by 6-ft. 5-in. Area "C", welding—8-ft. 3-in. by 9-ft. 10-in. Area "D", machinery—7-ft. 6-in. by 7-ft. 6-in. Area "E", balers—6-ft. 8-in. by 8-ft. 4-in. Area "F", punching—9-ft. 5-in. by 6-ft. Area "G", assembly tank parts—10-ft. by 6-ft.



BUILDING DATA

Area "A"	3,600 sq. ft.
Reflection factors—ceiling	30 per cent
walls	30 per cent
Ceiling height	14 feet

EXISTING INSTALLATION

Relocation of departments and use of storage space for manufacturing makes existing equipment unsuitable for work to be done in this area.

PROPOSED NEW INSTALLATION

New equipment	67 2/40 fluorescent industrial fixtures 134 40-watt white fluorescent lamps
Total lumens	281,400
Room index	"C"
Coefficient of utilization	.64
Maintenance factor	.75
Estimated intensity	37 foot-candles

Anticipated intensities range from 20 to 35 foot-candles. An extensive rewiring job was necessary to provide adequate branch circuit and feeder capacity for the increased lighting load anticipated. This work was already under way at the time application was made for the relighting rating on a previous priority rating.

PERTINENT DATA. The relighting involved several types of manufacturing directly on war work together with farm equipment ranking as essential civilian manufacturing.

New wiring was required in areas heretofore without lighting equipment such as storage buildings and areas used only in daylight. Existing wiring, feeders, panelboards and transformers were used wherever possible. The maximum demand of the system was estimated at 100 kw. for which sufficient additional service capacity was already installed under the rewiring program.

COMMENTS. The war pattern of the applicant was excellent and the existing lighting equipment obviously inadequate for the new war contract production. Three shift operation was essential. The proposed lighting system was reasonable in its consumption of critical materials and proposed an important and urgently needed improvement. A rating was granted.

Electrical Contracting, July 1942

INCANDESCENT LIGHTING IN A FOUNDRY

IMPROVED LIGHTING FOR NIGHT WORK AVERAGE INTENSITY OF 3 FT-C IMPROVED TO 25 FT-C WITH INCANDESCENT EQUIPMENT.

DESCRIPTION OF AREA. The foundry area for which the rating application was made is used for moulding steel castings. A lighting intensity of 15 foot-candles was considered appropriate for the accuracy of work required.

Up to the present time, the area had been used only during daylight hours for the operation described. Skylights and wide wall sash provided adequate visibility. Increased production requirements made it necessary to operate in the area 24 hours a day while the available lighting at night is adequate only for shake-out and clean-up.

The area in which new lighting was proposed totals 14,400 square feet. In this area the fixture height is 16 feet over 8,640 square feet and 14 feet over 5,760 square feet.

The ceiling in the entire area is irregular roof construction painted with aluminum paint which with the side walls is considered "dark" for lighting calculations.

EXISTING LIGHTING. The existing lighting system consists of 35 300-watt enameled reflectors providing measured intensities of 1 to 7 foot-candles, averaging approximately 3 foot-candles. A regular maintenance schedule includes wiping fixtures and lamps with a dry cloth every two weeks and washing every six months.

Estimated present demand and connected load is solely for lighting and totals 11 kw.

PROPOSED INSTALLATION. The applicant submitted a lighting plan proposing an installation of 108 500-watt incandescent lamps in glass shielded porcelain enameled reflectors to provide an average intensity of 15 foot-candles.

PERTINENT DATA. Twelve of the existing fixtures can be repaired and will be used in other plant areas. Wiring, as a result of work started in 1940 is adequate for the increased load involved. Local lighting is impractical as the entire area must be kept clear for crane operation and overhead monorail carriers.

BUILDING DATA

Total area lighted	14,400 sq. ft.
Area "A"	8,640 sq. ft.
Area "B"	5,760 sq. ft.
Reflection factor—ceiling	30 per cent
walls	30 per cent

EXISTING INSTALLATION

Equipment—
35 enameled steel reflectors in deteriorated condition
33 300-watt lamps
2 500-watt lamps

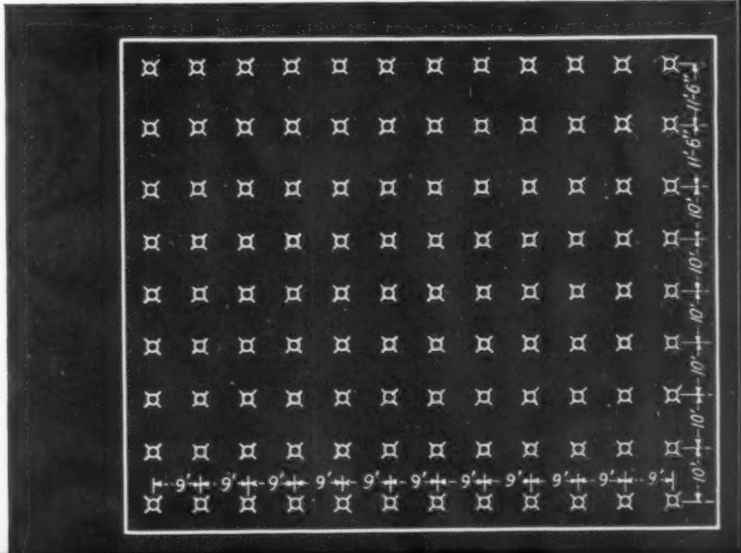
Mounting height area "A"	16 feet
Mounting height area "B"	14 feet
Connected load	11 kw.
Total lumens	209,750
Measured foot-candles	1.0 to 7.0
Reported average foot-candles	3

PROPOSED NEW INSTALLATION

New equipment—
108 porcelain enameled bowl type reflectors with glass covers
108 500-watt incandescent lamps

Total lumens	1,080,000
Estimated intensity	25 ft-c.
Connected load	54 kw.

COMMENTS. An analysis of the type of orders handled by the plant showed the work to be essential to the war program. The present lighting installation was inadequate for the work performed and the fixtures were in a deteriorated condition. The applicant's anticipation of 15 foot-candles was apparently derived from a load proportion. Analysis by conventional formulas based on new equipment showed 25 foot-candles. The applicant was granted a rating.



CONTINUOUS FLUORESCENT IN MOTOR MANUFACTURING

CRITICAL WORK REQUIRED INCREASE FROM EXISTING 10 FT-C INCANDESCENT LIGHTING WITH MINIMUM INCREASE IN POWER CONSUMPTION.

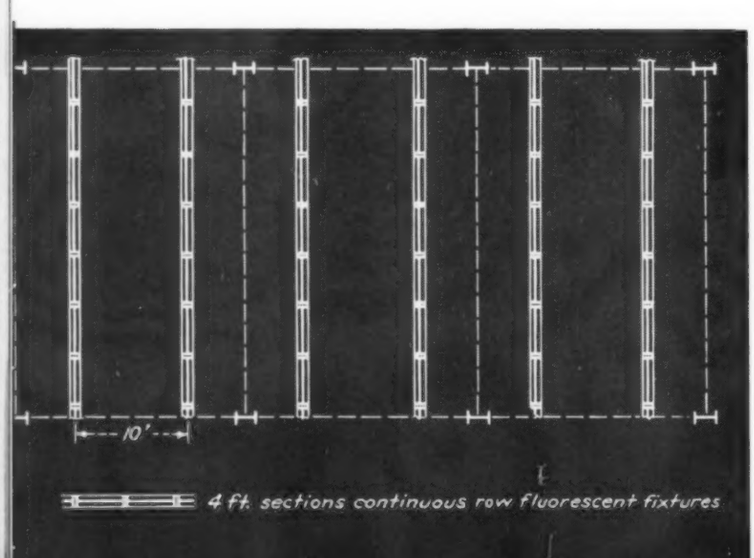
DESCRIPTION OF AREA. In a factory area to be used for the manufacture and assembly of small dynamotors, turret motors and searchlight motors for the armed forces. Ceiling and side walls were classified as medium in finish and reflection characteristics.

EXISTING LIGHTING. The applicant reported an existing installation of 328 300-watt glassteel diffusers serving an area of 48,600 square feet and providing a reported intensity of 10 foot-candles. A regular cleaning and maintenance schedule provided for washing the fixtures every three months.

Estimated existing kilowatt demand was 98 kw. of lighting and 585 kw. of power. The connected load was 98 kw. of lighting and 1140 kw. of power.

NEW INSTALLATION. The proposed new lighting installation was continuous rows of 2-lamp fluorescent units installed in the area to replace the existing filament equipment. Existing fixtures were removed for re-installation in other parts of the plant.

The continuous rows of 4-ft. units were to be installed 10 feet above the floor on lines 10 feet apart providing an estimated 50 foot-candles over the area with 1310 fixture units.



BUILDING DATA

Area in sq. ft.	48,600
Ceiling height	14' 6" to 25' 6"
Reflection factors—ceiling	50 per cent
walls	30 per cent

EXISTING INSTALLATION

Equipment	328—300-watt glasteel diffusers 328—300-watt incandescent lamps
Total lumens	1,886,000
Reported intensity	10 foot-candles

PROPOSED INSTALLATION

Anticipated load	127 kw.
Lighting proposed	1,310 2-lamp, 48-inch fluorescent industrial fixtures in continuous rows 2,620 40-watt white fluorescent lamps
Room index	"C"
Coefficient of utilization	.64
Maintenance factor	.75
Total lumens	5,502,000
Estimated intensity	54 ft-c.

PERTINENT DATA. An increase in the proposed lighting capacity with incandescent lighting units would require extensive rewiring and new feeders resulting in a lighting load of approximately 328 kw. while the same lighting intensity, according to the applicant's report, can be provided in the proposed installation with 127 kw. Local lighting would not satisfy the needs, it was reported, as it would provide too sharp contracts between the lighted area and the dark surroundings and in many cases it would be physically impractical to apply. The proposed fluorescent lighting system could be installed with a moderate increase in feeder, panelboard and branch circuit capacity with maximum use of existing materials.

COMMENT. While calculation indicated that about 15 foot-candles could be obtained from the existing system, the 50 foot-candles system proposed was desirable for the nature of the work. This installation required only a slight increase in wiring capacity, power consumption and demand. The existing lighting equipment was scheduled for use elsewhere in the plant. Consequently analysts recommended a rating for the project.

Electrical Contracting, July 1942

FLUORESCENT LIGHTING IN AN OFFICE BUILDING

MODERNIZATION OF THE LIGHTING SYSTEM IN A LARGE OFFICE BUILDING FOLLOWS LEASING OF SPACE TO WAR CONTRACTORS.

DESCRIPTION OF AREA. In a large office building, the applicant wished to carry out a lighting modernization plan in offices taken over by government agencies and war suppliers. Portions of the area are occupied by engineering firms as drafting rooms, other sections are devoted to general office work.

EXISTING LIGHTING. The existing incandescent lighting system consisting of direct diffusing glassware and 200-watt lamps provided 7 foot-candles. The ceilings are painted a flat white and side walls a light ivory. A regular maintenance schedule provides for dusting fixtures every month and soap and water washing every six months.

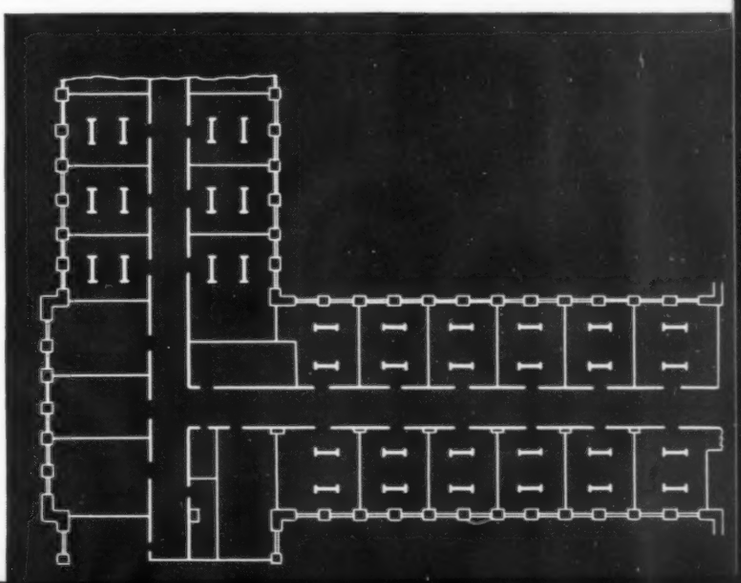
PROPOSED INSTALLATION. Under the lighting modernization plan, half of each wing on six floors were scheduled to be relighted with suspended fluorescent fixtures of the egg-crate louver type. Half of the units were specified with 6 40-watt lamps and half with 4 40-watt lamps. The number of units required for the entire relighting program totalled 1200.

The office building wings are divided into 300-sq.ft. bays partitioned into separate offices with two outlets in each space on 10-ft. centers. The reported anticipated lighting intensity was 20 to 25 foot-candles.

PERTINENT DATA. Under a previous rating 300 fixtures had been obtained to start the program. An additional 900 were required. Many of the engineering offices are now operating on a 16-hour schedule requiring long hours of work without supplementary daylight. The building connected load is 3500 kw., 2500 of which is lighting. It was estimated that the fluorescent installation would save approximately 350 kw. To provide an effective increase in illumination with incandescent equipment would require rewiring and new feeder circuits, according to the report. The proposed fluorescent installation, however, could be installed on the existing outlets.

BUILDING DATA	
Total area lighted	approximately 150,000 sq. ft.
Reflection factors—ceiling	75 per cent
walls	50 per cent
Ceiling height	12 feet
EXISTING INSTALLATION	
Each 300 sq. ft. bay	2 diffusing globes 2-200-watt incandescent lamps
Reported intensity	7 ft-c.
PROPOSED INSTALLATION	
New equipment—	
Each 300 sq. ft. bay	1 4-lamp louvered unit 1 6-lamp louvered unit 10 40-watt fluorescent lamps
Total lumens	21,000 per bay
Mounting height	9 feet
Room index	"E"
Coefficient of utilization	.40
Maintenance factor	.65
Estimated intensity	18.2 ft-c.

COMMENTS. As the modernization program of this applicant was keyed to space occupied by war connected business and government offices the war pattern is good. The existing lighting is not adequate for detailed office work and an increase in lamp sizes would seriously overload the wiring system capacity. The type of units specified could be installed without extensive changes in wiring or additional power resources. A rating was assigned to the project.



FLUORESCENT LIGHTING IN A CLINICAL LABORATORY

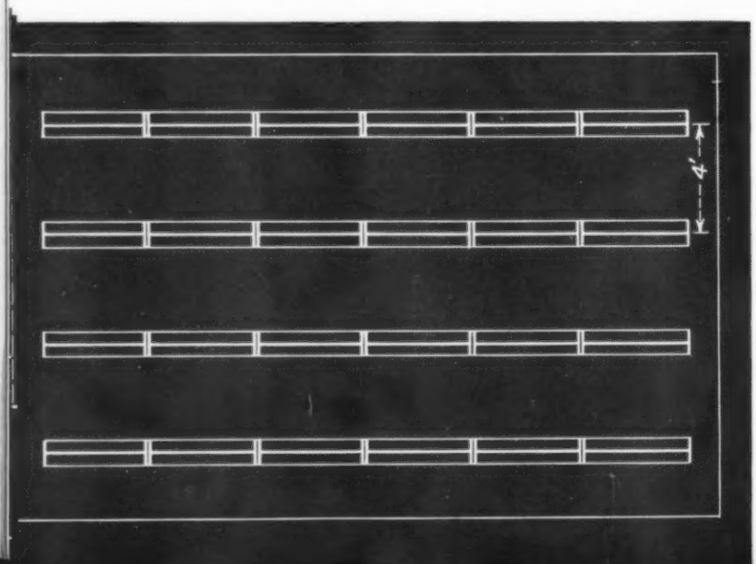
IN A REMODELED HOSPITAL WARD, NEW FLUORESCENT CEILING UNITS PROVIDE AN ESTIMATED 44 FOOT-CANDLES.

DESCRIPTION OF AREA. A hospital submitted a request for priority assistance to obtain new fluorescent lighting equipment for a clinical laboratory. The space previously occupied by a hospital ward, was recently remodeled and equipped for laboratory work.

The room is 26 feet long and 17 feet wide, totalling 442 square feet. Ceiling and side walls were painted a flat egg shell white providing excellent reflection factors. The ceiling height is 13 feet.

EXISTING LIGHTING CONDITION. The ward lights, consisting of indirect bowls equipped with 150-watt lamps and a 10-watt blue lamp for night lighting, were reported as inadequate for the exacting work of the laboratory and were removed during remodeling for use in other parts of the hospital building.

PROPOSED INSTALLATION. The application requested a rating for an installation of surface mounted, continuous row fluorescent luminaires consisting of a wiring channel, and a glass diffusing enclosure made up in four foot sections with two 40-watt fluorescent lamps. An average illumination intensity of 40 foot-candles was anticipated and was to be aided wherever necessary by local lighting from special laboratory equipment.



BUILDING DATA

Total lighted area	442 sq. ft.
Ceiling height	13 ft.
Reflection factors—ceiling	75 per cent
walls	50 per cent

EXISTING INSTALLATION

Lighting equipment	4 bowl type indirect suspended fixtures 4 150-watt incandescent lamps

Area remodeled from hospital ward and units used elsewhere in same building.

PROPOSED INSTALLATION

New equipment	24 2/40-watt direct diffused fluorescent lighting units. 48 40-watt white fluorescent lamps
Unit spacing	Continuous rows 4-ft. apart
Room index	"H"
Coefficient of utilization	.30
Maintenance factor	.65
Mounting height	13 ft.
Total lumens	100,800
Connected load	2,100 watts
Estimated intensity	44 foot-candles

PERTINENT DATA. The application included a tabulation of the amounts of critical materials required for the new lighting installation and reviewed the types of seeing tasks involved in such laboratory work under the pressure of wartime conditions. This data, while not essential for the rating request, emphasized its urgency.

Additional wiring required for the lighting system was already installed under a separate rating. The power resources, derived from the hospital's power plant, was sufficient to handle the additional load without added equipment.

COMMENTS. Existing lighting equipment in the area was obviously unsuitable for the critical seeing tasks of a clinical laboratory. The type of lighting unit proposed, while providing good diffusion and light control uses relatively small amounts of critical materials and no additional allocations of scarce materials were needed for the wiring. The essential character of the use, the urgency, and the satisfactory design of the lighting installation were established. The hospital authorities were granted a rating.

Electrical Contracting, July 1942

FLUORESCENT LIGHTING IN A TEXTILE MILL

CONVERSION OF A WEAVE DEPARTMENT TO 24-HOUR SCHEDULES REQUIRED LIGHTING IMPROVEMENT PROVIDED BY INDUSTRIAL UNITS.

DESCRIPTION OF AREA. A textile mill requested a rating to obtain new fluorescent lighting in a weave shed. The area involved totalled 9,000 sq. ft. with a 14 foot ceiling. Reflection factor of 75 per cent for the ceiling and 50 per cent for the side walls were reported based upon white and light gray paint respectively.

EXISTING LIGHTING. The existing lighting provided approximately 6 foot-candles from 100-watt lamps on drop cords, about half equipped with reflectors of an obsolete type in poor condition, inadequate for three shift operation. The connected load was 7.2 kw. of lighting and 89.5 kw. of power.

PROPOSED INSTALLATION. The new installation proposed by the applicant would provide an estimated 25 foot-candles from 2/40 fluorescent industrial fixtures on the same outlets.

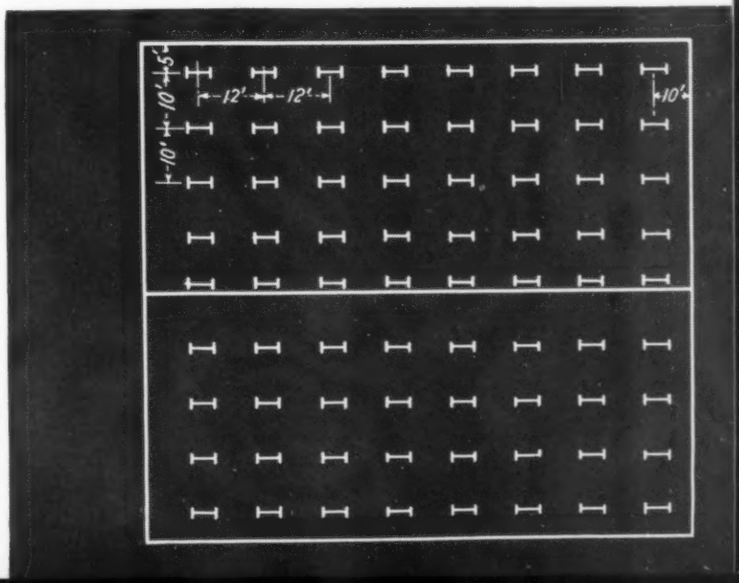
PERTINENT DATA. In the area where this plant is located there is a potential power shortage due to extensive conversion and capacity operation of equipment in the surrounding mills. It was considered undesirable to increase the new demand if it could be avoided by holding the connected load to a minimum. Fluorescent lighting provided an opportunity to increase the effective illumination without materially increasing the demand. Existing wiring, while in some need of repairs, was adequate to serve the new fluorescent lighting system.

A similar installation in another part of the mill had contributed to a definite increase in production, improved quality and better working conditions. This installation was identical in luminaire spacing, mounting height and conditions of surrounding ceilings and side walls to the installation proposed under this application.

COMMENTS. The war pattern of this mill was excellent, almost 100 per cent A-1-j or better.

BUILDING DATA	
Total area lighted	9,000 sq. ft.
Reflection factors—ceiling	75 per cent
walls	50 per cent
Ceiling height	14 feet
EXISTING INSTALLATION	
Present equipment	72 drop cords, approximately half with cone reflectors 72 100-watt incandescent lamps
Average intensity	6 foot-candles
Maintenance	regular cleaning
Connected load	7.2 kw. lighting 89.5 kw. power
PROPOSED INSTALLATION	
New equipment	75 2/40 industrial fluorescent fixtures 150 40-watt white fluorescent lamps
Mounting height	11 feet
Total lumens	315,000
Room index	"A"
Coefficient of utilization	.74
Maintenance factor	.75
Estimated intensity	19.4 ft-c.
Estimated load	7.5 kw.

The power supply conditions in the area were critical and increased illumination from additional incandescent lighting would require a significantly large increase in demand. The new lighting system proposed was a large increase in illumination, however, analysis indicates that the resulting illumination will be less than the anticipated 25 foot-candles reported. The project was assigned a rating high enough to obtain the necessary fluorescent lighting equipment.



FLUORESCENT REFLECTORS IN A FORGE SHOP

NEW LIGHTING UNITS IN A TEMPORARY STRUCTURE WITHOUT EXISTING LIGHTING PROVIDES 17 FOOT-CANDLES FOR A FORGE DIE ROOM TO ALLOW EFFICIENT NIGHT SHIFT OPERATIONS.

DESCRIPTION OF AREA. The applicant requested a rating to obtain new fluorescent lighting equipment for a new die room addition at a forge. Recent large war orders were requiring 24-hour operation in the plant and additional die room space.

The addition is a frame structure 16 feet high covering an area of 2,544 square feet. The interior surfaces are natural wood unpainted ceilings and side walls. The reflection characteristics were classified as relatively dark and for the purpose of estimating probable lighting intensities were indicated as 30 per cent for ceilings and 30 per cent for walls.

EXISTING LIGHTING CONDITIONS. As the structure is new, no lighting is yet installed in this area. The kind of lighting equipment to be installed also determines the wiring layout and feeder capacity required. The original plans and specifications were based upon the use of fluorescent lighting and the materials necessary for wiring to these specifications are available.

PROPOSED INSTALLATION. The proposed layout involves 24 new 2/40 fluorescent industrial lighting fixtures spaced on 10 by 10 feet centers and suspended 10 feet from the floor. Under existing reflection factors the anticipated intensity as reported in the application is approximately 20 foot-candles.

BUILDING DATA

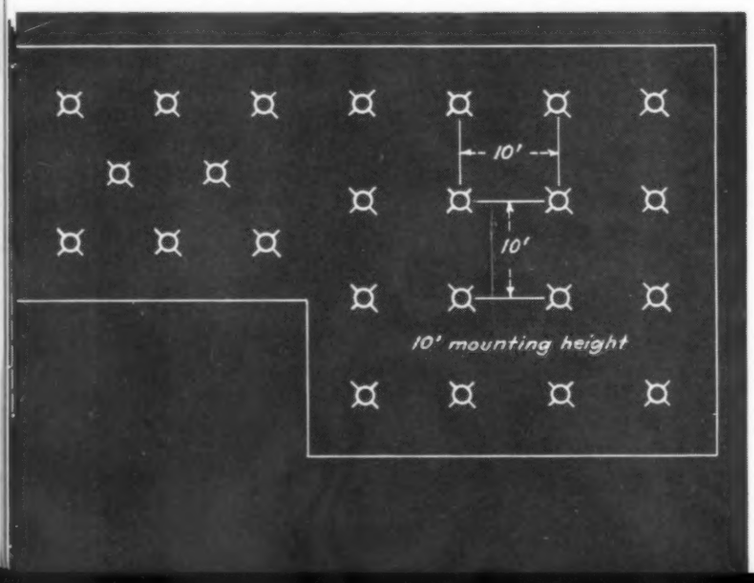
Total area lighted	2,544 sq. ft.
Ceiling height	16 ft.
Reflection factor:—ceiling	30 per cent
walls	30 per cent

PRESENT INSTALLATION

No existing lighting in this area

PROPOSED INSTALLATION

New equipment	24 2/40-watt industrial fluorescent units 48 40-watt fluorescent lamps
Spacing	10 by 10 feet
Height	10 feet
Total lumens	100,800
Room index	"B"
Coefficient of utilization	.67
Maintenance factor	.65
Estimated intensity	17.2 ft-c.
Estimated load	2.4 kw.



PERTINENT DATA. The war pattern of the orders handled in this plant are 71 per cent A-1-a, 10 per cent A-1-b, 17 per cent A-1-f to j and 2 per cent other. The need for lighting in the area was urgent. New wiring required was being installed and materials obtained under a separate rating. The space is already in use and night shifts must use portable lamps to work in the area. A new incandescent installation of equal intensity would require more wiring, panelboards and a heavier feeder circuit.

COMMENTS. The applicant has a very high ranking war pattern, almost 100 percent A-1-j or better. The new wiring is being installed under a separate rating. Incandescent equipment would require larger quantities of scarce material for wiring and service. The installation designed is satisfactory for the type of work involved. A rating was assigned for the project.

Electrical Contracting, July 1942

FILAMENT INDIRECT LIGHTING IN AN OFFICE

NEW LIGHTING IN AN AREA USED BY A GOVERNMENT WAR AGENCY PROVIDES MODERATELY IMPROVED ILLUMINATION USING PREVIOUSLY INSTALLED ADDITIONAL WIRING CAPACITY.

DESCRIPTION OF AREA. An office area rewired in 1936 but never equipped with fixtures, was to be taken over by a local administrative office of one of the government war agencies. The area, a portion of a large office building, covers 9,025 square feet. The ceilings are 11 feet high finished in flat white paint. The side walls are a light ivory.

EXISTING LIGHTING CONDITIONS. Old fixtures designed for 200-watt lamps and producing an average of 7 foot-candles on the working plane had been discarded.

PROPOSED INSTALLATION. The lighting system proposed for priority rating was an installation of semi-indirect incandescent lighting units to be mounted on the existing outlets. This type of lighting unit had been adopted as a standard throughout the building.

With 94 units of 300 watts each the anticipated intensity of the proposed installation was 18 foot-candles under the good reflection characteristics of the surrounding white ceilings and light ivory side walls.

The estimated demand and connected load for the new lighting was 30 kilowatts. No significant power load was anticipated in the area.

PERTINENT DATA. Existing feeder capacity and branch circuits are designed to handle the type of lighting system proposed. Power is purchased from the local utility company and the building is located in an area where there is ample distribution and generating capacity. The area is wired with four outlets to each 16 by 20 foot bay with one branch circuit per bay. Runs between outlets are No. 12 with No. 10 home run to the panelboards.

BUILDING DATA

Total area lighted	9,025 sq. ft.
Reflection factors—ceiling	75 per cent
walls	50 per cent
Ceiling height	11 ft.

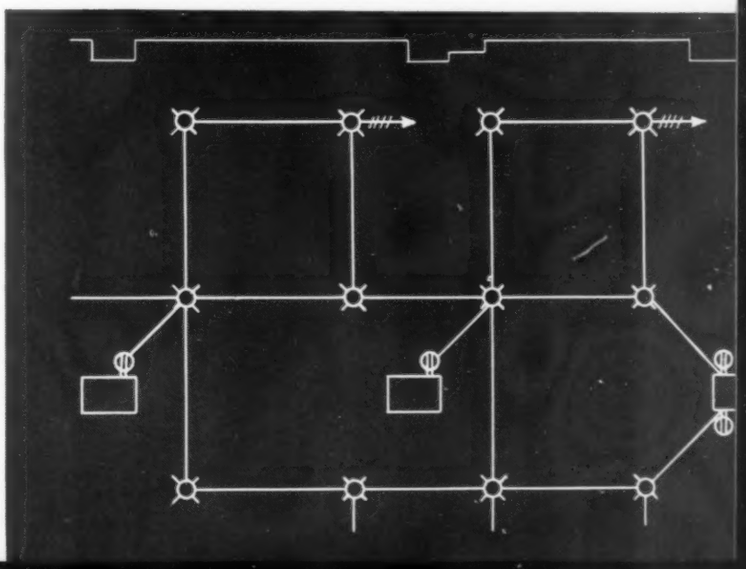
EXISTING INSTALLATION

No fixtures now installed. Rewiring in 1936 provided four outlets in each 20 by 16 foot bay.

PROPOSED INSTALLATION

New equipment	94 semi-indirect incandescent lighting fixtures 94 300-watt incandescent lamps
Total lumens	540,500
Room index	"C"
Coefficient of utilization	.42
Maintenance factor	.65
Mounting height	8-ft. 6-in.
Estimated intensity	16.4-c.
Estimated load	30 kw.

COMMENT. The new lighting system was required for an essential government office and the request for priority assistance based upon a moderate amount of new materials. There are ample power resources in the area for the additional load. The anticipated lighting of 18 foot-candles reported was considered reasonable for the type of work to be handled in the area. A rating high enough to obtain the required fixtures was granted.



FLUORESCENT UNITS IN A SHOE FACTORY

FLUORESCENT UNITS REPLACE INCANDESCENT ON EXISTING OUTLETS TO IMPROVE GENERAL LIGHTING FOR NIGHT SHIFT OPERATION AND REDUCE CONTRAST WITH LOCAL MACHINE LIGHTING.

DESCRIPTION OF AREA. In a shoe manufacturing plant heavy government orders were requiring round-the-clock production. The ceiling is unpainted open joists. Side walls are painted gray to a height of 4 feet above the floor and white to the ceiling. Reflection characteristics of the ceiling are low while the side walls are medium.

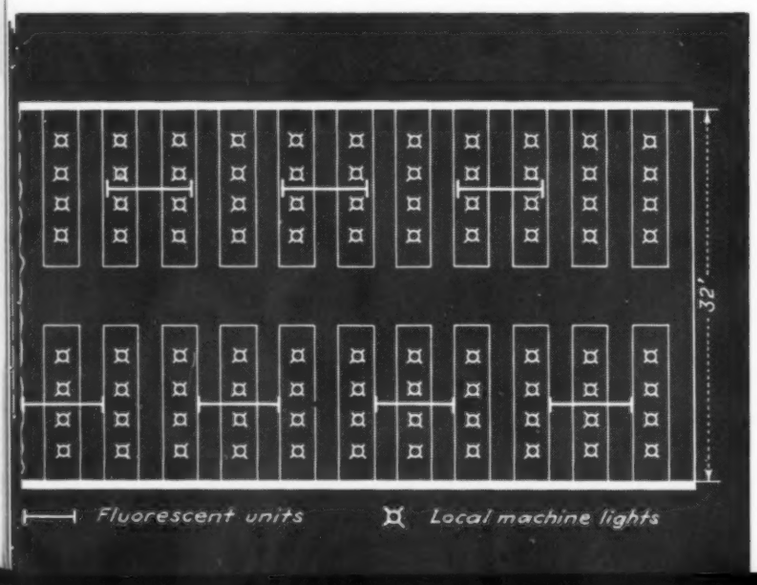
EXISTING LIGHTING. In a stitching department, the general lighting averaged 7 foot-candles aided by local lighting at the stitching machines which was restricted to small bright areas. The consequent contrast with the comparatively dark surroundings was great. Existing general lighting was reported as 200-watt porcelain enameled steel reflectors and 200-watt incandescent lamps on 15 foot centers. The fixtures were suspended from drop cords to a height of 10 feet above the floor providing a measured lighting intensity of 5 to 7 foot-candles. The connected load for the area was 6 kw.

NEW INSTALLATION. The new lighting proposed for the stitching area was an installation of 2 lamp 4-ft. fluorescent industrial fixtures installed on the existing lighting outlets at the same height as the present fixtures. This layout would provide an estimated average general illumination of 15 foot-candles according to the applicant's report, an effective improvement over the existing lighting, without requiring additional wiring or feeder capacity.

BUILDING DATA	
Total lighted area	6,855 sq. ft.
Ceiling height	12 ft.
Reflection factors—ceiling	30 per cent
walls	50 per cent
EXISTING INSTALLATION	
Lighting equipment	30 enameled steel reflectors on drop cords 30 200-watt incandescent lamps
Total lumens	111,000
Reported intensity	5 to 7 foot-candles
PROPOSED INSTALLATION	
New equipment	50 2/40-watt industrial fluorescent lighting units 100 40-watt white fluorescent lamps
Total lumens	210,000
Room index	"C"
Coefficient of utilization	.60
Maintenance factor	.75
Estimated intensity	15 ft-c.

PERTINENT DATA. The existing fixtures can be used in other parts of the plant in halls and aisle areas where no lighting is now provided. No additional wiring is required for the proposed lighting installation as existing circuits and feeders have sufficient capacity. The connected load for the fluorescent units is estimated at about 1 kw. less than the present lighting load.

COMMENTS. The new fluorescent lighting installation can be made without adding wiring capacity. The existing lighting levels are considerably inadequate for the type of work involved. The estimated 15 foot-candles from the proposed installation is not as high as existing standards recommend, however it is an effective improvement in lighting over that existing. The request was granted a rating.



Electrical Contracting, July 1942

BLACKOUT GUIDE

CONVERSION LIGHTING

OFFICIAL SPECIFICATIONS are now complete to govern the blacking out of all types of buildings, both interior and exterior, and of street lighting during such periods and in such areas as this section is ordered by military authority. The specifications have been developed by the Engineer Board, research agency for the Corps of Engineers, U. S. Army, in consultation with other technical groups, and their terms apply equally to military and civilian defense authorities where actual air raid alerts are sounded.

Production of some items of specified blackout lighting equipment may not be adequate at this time for all who need it, but negotiations are in progress among the proper authorities in Washington to obtain an allocation of raw materials for the job. Any allocations that are made, however, are certain to be in minimum amounts for absolutely essential uses. Therefore, it is emphasized that no purchases of lighting equipment should be made until approved equipment can be secured and no purchases at all should be made of such equipment for use outside the zones in which passive protective measures are to be taken. At present, under terms of the revised WPB order L-28, a rating higher than A-2 is required to obtain incandescent blackout lamps and manufacturers are limited to approved types. Similar restrictions covering fixtures may be expected.

Contractors in coastal areas generally considered within enemy air striking distance can determine for themselves and their customers whether they are in such areas by checking with local OCD authorities, who, in turn, will receive instructions on this subject from the commanding generals in charge of the affected areas.

In the regions designated for passive protective measures the blackout specifications and any dimout regulations issued by the Army command take precedence over all others, including previously required anti-sabotage floodlighting, etc. Anti-sabotage protective lighting, however, remains in operation outside the designated military areas.

All approved blackout lighting equipment will carry the words: INTERIOR BLACKOUT—WAR DEPT. STANDARD, for use inside of buildings, or STREET BLACKOUT—WAR DEPT. STANDARD, for any exterior use. Manufacturers must submit their designs to an approved testing laboratory for advance test and report to the War Department before approval of the use of the markings on individual products will be given. At present, the Electrical Testing Laboratories, Inc., is the only accredited testing laboratory for this purpose. This approval applies only to lighting fixtures, lamps and wiring; there will be no labeling of approved materials for blackout by obscuration.

Interior Lighting

INTERIOR BLACKOUT OF BUILDINGS may be achieved in any one of three ways or combination of them: Extinguishment, obscuration or reduction of illumination to specified maximum intensities through use of approved equipment.

Extinguishment of lights is termed by the War Department as "not generally desirable." The specification states that "widespread application of this method causes serious disruption of normal military, industrial, commercial and home activities with attendant confusion, accidents, and possibly lowered morale—the very objectives sought by enemy air raids." This procedure is required only where advance preparation has not been made for either of the other two methods.

Obscuration is the recommended procedure for the more essential sections of industrial plants and other structures in which war activities are carried on. In residences at least one room should be tailored for obscuration. The specification points out that the depressing effect of black materials may be overcome to a large extent by selecting materials which are light colored on their inside surfaces or by a coat of light paint over the required drab or black.

This method requires that necessary advance preparations be completed to insure that windows, exterior doors and other openings through which light might escape are made completely light-tight within *two minutes* after the official blackout signal is given. Obscuration may be accomplished by use of paint, adhesive coverings, screens and shutters, light locks, "or any other means which will permit normal interior illumination without exposing any light on the outside."

Wherever possible it is a good idea to apply obscuration materials to the outside surface to minimize reflec-

tion from glass, etc. This is required in the case of skylights and other glass areas that are not vertical.

Paint

Paint used for obscuration must be weatherproof, lusterless (mat or low gloss) and drab or black in color; it should be easily removable and require only one coat for complete opacity. Careful application is necessary to avoid "missed spots." Paint is stated to have several disadvantages—when the glass is shattered light is exposed, artificial illumination is required in daytime, heat absorption by the paint may affect work inside the building or shatter the glass.

Prior cleaning, especially to remove all grease, is required when adhesive coverings are used. Materials must be opaque, adhere strongly to the glass and should possess considerable tensile strength or elasticity to absorb some shock. Cloth, paper or fibrous materials are permitted. Such coverings have the same disadvantages for obscuration purposes as paint.

Opaque shades, drapes, blankets, builder's paper and similar materials all are permitted for light obscurement by screening. These must be placed with an overlap of 6 to 8 inches on all sides. When rigid screens or shutters are used they must either fit neatly in channels designed for the purpose or sufficiently overlap the opening to prevent light leakage; it is desirable that the screens be held in place by flexible or elastic means to absorb some blast shock. "Any type opaque covering material which meets the above conditions will be satisfactory," the specification states.

Light Locks

Entrances, exits and ventilation openings all must be fitted with light locks. These consist essentially of passageways (or vents) with dull black surfaces, with inner and outer openings offset, and so constructed that no light, direct or reflected, is visible from the outside. Light sources near the interior openings of light locks must be shielded so that no direct light enters the lock.

Reduced illumination, the third method of achieving blackout of interior lighting, may be accomplished either by use of a special blackout lighting fixture or approved type incandescent lamp.

Fixtures

The blackout fixture must have a minimum of 1½ and a maximum of 3 initial lumens to a light-adapted eye. Initial candlepower at any angle, again to a light-adapted eye, may not exceed 1. Most of the light must be in one hemisphere; not more than 0.15 lumen is permitted in the second hemisphere. The light must be either orange or orange-red—blue has been abandoned entirely—and the unit must be of "rugged construction and not subject to derangement, tampering or misuse."

Lamps

Blackout incandescent lamps may not exceed 15 watts and must have a medium screw base and an A-15 type bulb. Voltages are limited to 120 volts (lamp to be marked 115-125 volts) for general lighting service, 240 (marked 230-250 volts) for high voltage service, and 32 volts (marked 30-34 volts) for country home and transportation service. The bulb must have an average laboratory life of 1,000 hours or more at rated voltage. It must be opaque coated except for an orange or orange-red circular aperture not exceeding one inch in diameter on the bulb end. Only black is permitted for the opaque coating material and this must be resistant to scratching or removal—pinholes are permitted, however, so long as not more than 0.15 lumen of light escapes into the second hemisphere.

Unit Mounting

Indoor blackout units, including incandescent lamps, as described above may be used only in accordance with these directions:

1. In small or medium-sized rooms (not over 200 sq.ft. of floor area)—one unit per room.
2. In larger rooms and in corridors—not more than one unit per 100 sq.ft. of floor area.
3. Units must always be at least 10 ft. apart and 3 ft. from any window, exterior door or other opening. They may not be pointed toward any such opening.
4. When openings are covered with drawn window shades, drapes, blinds, or even one thickness of newspaper, units may be installed at any height. When exterior openings are not covered, blackout units shall be located above the top of such openings.

Luminescent materials are permitted for indoor blackout under certain restrictions, but the specification indicates that their use is limited. Phosphorescent materials are permitted for outlining doors, knobs, switches, stairs, elevators, railings, corridors, paths to shelters, first aid stations, rest rooms, etc., but it is stated that controlled laboratory applications of this material usually give better results than at the point of use.

Fluorescent Materials

In most instances, the specification states, indoor blackout units or lamps "will provide reduced illumination more efficiently than will a combination of ultraviolet radiation and fluorescent materials." When fluorescent material is used, however, at locations where the glow is visible outside the building, the surface brightness of the materials shall not exceed 0.001 foot-lambert and the ultraviolet source shall be completely invisible from the outside. High cost of radioactive markers and tape is considered to limit their usefulness, although they are available where a continuous brightness higher than phosphorescent is desirable. Only tape or markers approved by the War Department may be used at all and these must be handled as directed.

Exterior Lighting

THE WAR DEPARTMENT SPECIFICATION for exterior blackout lighting requires an electrical system separately operated from the normal lighting system, whether it be street lights or illumination of docks, loading platforms, plant yards and grounds, open sheds, etc.

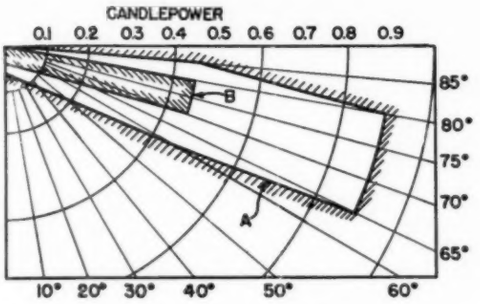


FIG. 1—Mounting height 9 to 14 ft.

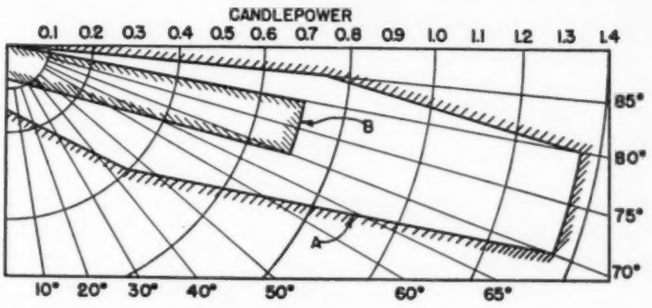


FIG. 2—Mounting height 15 to 19 ft.

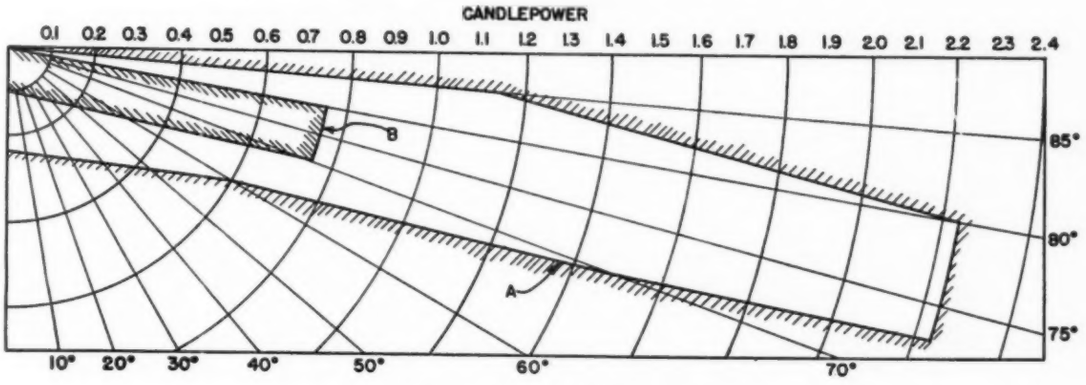


FIG. 3—Mounting height 20 ft. and upward

LIMITS OF polar curves of candle-power distribution for blackout street lighting luminaires at the mounting heights indicated

It is not proposed, however, that extensive blackout lighting installations be made until there is reason to expect frequent or prolonged periods of blackout.

Exterior blackout lighting, even then, is intended to be installed only where complete elimination of all artificial lighting is not desirable. Total light extinguishment is "the most effective possible blackout," but it is recognized that this would seriously handicap the activities of military and civilian defense personnel "at the very time when it is of vital importance that they be able to move about and perform their services efficiently."

In general, according to the specification, blackout lighting will be considered necessary "where substantial pedestrian movement is expected during blackouts—business and office districts, shopping centers, roads and walks leading to war plants, important crosswalks on heavily traveled thoroughfares, etc."

Intent of the specification is to provide "the greatest possible illumination for ground activities commensurate with reasonable protection from aerial observation." In terms of illumination this is defined as being an average of approximately 0.0003 foot-candle on a horizontal surface at street level; at no point may it exceed 0.0006 foot-candle. This is about double the light provided by starlight on a clear, moonless night.

Exterior blackout light must be "white" as produced by a tungsten-filament lamp operating at approximately its rated voltage. Blue light has been abandoned entirely by the Army as a blackout light because: "(1) It is most easily detected from the air by dark-adapted aerial observers; (2) it provides hazy and indistinct visibility for ground activities, and (3) it becomes useful on the ground only after a relatively long period of dark adaptation of vision."

Normal Lighting

Except during blackout periods, it is intended that normal lighting shall prevail. The specifications unequivocally opposes use of "dim-out" methods as a means of reducing danger of aerial spotting, stating:

"Any curtailment of present street illumination at other times is not recommended. Reduction in voltage, lamp size, or number of street lamps results in added traffic hazard without any significant decrease in ease of detection and identification from the air."

(In coastal areas, of course, dim-out measures may be ordered by the military for eliminating sky-glow which silhouettes shipping for submarine attack. This is a separate wartime lighting problem and a covering specification is being developed.)

Subject to later directions from the military commanders having charge of specific areas, the specification proposes that at this time the only steps to be taken are arrangements for extinguishing all normal lighting within *two minutes* after an official blackout signal, and development of blueprint plans for blackout installations to be available for immediate use if necessary.

Location

Officials responsible for street lighting in those areas designated by military authority as requiring passive protective steps should first determine the locations where blackout units would be required in the event raids

or threatened raids became frequent. Commercial and industrial concerns with lighting problems independent of municipal street lighting should initiate the same program. Both should act in consultation with military authorities.

Once potential blackout lighting locations are determined, surveys should be made of the equipment required and the amount on hand which can be used; in this connection, the specification points out that iron wire is adequate for the purpose. Detailed plans should be drawn up showing placing and mounting of each blackout unit—then filed until they are needed.

Blackout Circuits

Specifically designed blackout lighting luminaires (marked: STREET BLACKOUT — WAR DEPT. STANDARD) and War Department-approved incandescent blackout lamps (marked: FOR USE IN BLACKOUT LUMINAIRES) will both be required wherever exterior blackout installations are made. It is recommended that blackout circuits be connected in multiple to secondary distribution lines, without switching provision, and burned continuously—the method considered "likely to result in lowest over-all cost, besides conserving labor and materials and insuring that the blackout lighting will be on whenever needed." Permissible, however, is installation of switching equipment and assignment of personnel to turn on the blackout circuits within the *two-minute* period after an alert in which normal lighting is being extinguished.

Blackout luminaires shall be so constructed that, when equipped with blackout lamps, the candlepower distribution curve of the luminaire is, in all vertical planes, wholly inside the limiting curve "A" in Figs. 1, 2 or 3, according to the appropriate mounting height. The distribution curve in any vertical plane making an angle of less than 45 deg. with the vertical plane parallel to the street axis shall lie outside the corresponding limiting curve "B" in the same figures. Construction of the limiting curves in these figures are based on the values in the following tables, respectively:

Table 1—Candlepower for Nominal 10-Ft. Mounting Height (Fig. 1).

Angle	Curve A	Curve B
0°	0.06	0.03
60°	0.45	0.13
65°	0.90	0.22
70°	0.90	0.45
80°	0.90	0.45
85°	0.45	0.00
90°	0.00	0.00

Table 2—Candlepower for Nominal 15-Ft. Mounting Height (Fig. 2).

Angle	Curve A	Curve B
0°	0.14	0.07
45°	0.40	0.15
70°	1.35	0.70
80°	1.35	0.70
85°	0.75	0.00
90°	0.00	0.00

Table 3—Candlepower for Nominal 20-Ft. Mounting Height (Fig. 3).

Angle	Curve A	Curve B
0°	0.25	0.10
60°	0.60	0.35
70°	1.50	0.75
73°	2.25	0.75
80°	2.25	0.75
85°	1.15	0.00
90°	0.00	0.00

All photometric tests to determine compliance with this specification must be conducted in a nationally recognized testing laboratory and not by street performance, because of the difficulties and inaccuracies inevitable in outside measurements of such low values. Equipment used must be capable of measuring 0.03 to 2.25 candle and tests must be made with a receiving surface not less than 2 ft. from the light source with the lamp operated at or near rated lumen output. A detailed appendix is attached to the specification to outline instructions for conducting these tests.

Luminaires are to be mounted at heights dictated by the light distribution values. Manufacturers will mark their products for 10, 15 or 20-ft. mounting height and the permissible range is that shown in the three light distribution curves. Units must be more than 100 ft. apart, measured along a line joining them in plan and preferably at least 150 ft. apart. Single units may be used at isolated locations.

It is expected that, except in unusual instances, existing wood or metal poles will be used, with those selected which afford reasonably uniform spacing yet maximum permissible illumination at crosswalks, intersections and similar points of hazard. Units must be mounted rigidly and properly oriented if they provide an asymmetric distribution of light. When close to light-colored surfaces or expanses of water, dull black screens are required to prevent direct light from falling on these surfaces.

Blackout luminaires are to be constructed as small as practicable, preferably with an over-all dimension of not more than 8 to 10 inches—two British models which are of acceptable design are illustrated on this page. The units are to be ruggedly built and not subject to deterioration such as would bring the photometric performance outside the specification limits. Manufacturers must obtain advance design approval and obtain a serial number to be stamped on each product.

The incandescent lamps employed in these luminaires shall be 10-watt inside frosted lamps which have been especially designed for the long life and resistance to shock required in this use. Where an approved blackout lamp is not available, a 10-watt inside frosted general service lamp may be used as a temporary expedient. But there is no lamp which is permitted for exterior blackout lighting except in approved blackout luminaires, and no lamp other than 10 watts for use inside the fixtures.

These outside blackout units should be inspected at least once a week to insure that they are in proper operating condition. Cleaning of luminaires is recommended at least twice a year, oftener in smoky areas. Where blackout lighting burns continuously, periodic replacement of lamps is recommended every four months. Where the units are switched on only for tests and during blackouts, replacement nearly as often will be found necessary because low-wattage filaments are less able to withstand vibration and shock when cold than when burning and after four to eight months their mechanical strength is likely to be seriously impaired.

Exterior blackout restrictions do not limit the use of phosphorescent or radioactive materials. Fluorescent materials are also permitted, but only to a surface brightness of 0.001 foot-lambert with the source invisible.

ROUND-THE-CLOCK LIGHTING

CONVERSION LIGHTING

DRAFTING ROOM conversion layout for night work provides 50 foot-candles in service. Deep symmetric reflectors are installed in continuous rows on an angular pattern to prevent line shadows.

PATTERN SHOP WORK requires accurate and quick seeing under adequate illumination for war time production schedules. Industrial fluorescent units installed during conversion provide over 40 foot-candles in this busy shop.

MACHINE OPERATIONS on essential war material must run through three shifts with equal precision and speed. Conversion in this shop included a new installation of fluorescent industrial lighting fixtures for improved general lighting.

MAINTAINING WARTIME LIGHTING

MAINTENANCE IS THE BACKBONE OF GOOD LIGHTING OPERATING EFFICIENCY. WE MUST MAKE THE MOST OF WHAT WE HAVE. HERE ARE SOME SUGGESTIONS FOR DOING JUST THAT.

GOOD LIGHTING has become an important part of the design of our war production plants, whether they be new, existing or converted manufacturing units. However, responsibility for high intensity lighting does not end with the design and installation of the system—it is merely transferred to the plant maintenance department. It is their job to follow through and make certain the designed lighting efficiencies are maintained.

The importance of lighting maintenance is clearly indicated by the fact that light output can depreciate to less than one-half of initial value due to dirt and dust.

Now is the time to bring lighting maintenance up out of the cellar, to place it on equal terms with motor and machinery maintenance. For, workers are unaware of gradually reduced light output until eyes begin to smart, headaches come and production slumps. Then the damage has been done. Prevent this and production will be kept on the upgrade.

The Maintenance Program

There is no priority on lighting maintenance. A successful program requires the non-critical elements of a good cleaning fluid; some honest-to-goodness elbow grease; a healthy portion of down-to-earth common sense; and a highly organized plan of systematic inspection, cleaning and relamping. Such a program should include:

LAMP REPLACEMENT should be made on a group basis. Highest efficiency is obtained when all lamps of a unit are replaced at the same time.

1. A complete set of records with data compiled from a periodic check-up of the entire lighting system.
2. A cleaning schedule for systematic washing and reconditioning of lighting fixtures.
3. A lamp replacement and inspection schedule for periodically replacing lamps that are approaching the end of their rated life.
4. A painting schedule for periodically repainting the building interior together with contrast painting of process machinery.
5. Recommendations for the installation of equipment and devices to facilitate fixture and system maintenance.
6. Periodic inspection of the distribution system including load and voltage checks to maintain system efficiency.
7. A spare parts stock including a reasonable number of spare lighting units, lamps, parts and accessories.

Fixture Maintenance

The logical place to start looking for trouble is at the lighting unit itself. Probably more can be done here to increase light output than elsewhere on the system. Giving dirty fixture reflectors a good bath will sometimes increase light output as much as 50 per cent.

1. Cleaning Schedules

No Definite Rule for cleaning periods can be made. They may vary in each plant depending upon the type of work illuminated, the quantity and type of fumes and dirt in the atmosphere, and the general cleanliness and conditions around the plant.

A one-third decrease in light output is sometimes taken as the criterion for cleaning the units. The time period between cleanings, based on such depreciation, may vary with the conditions in different plants or separate departments of a single plant. Schedules worked out on this basis can be determined by checking the illumination intensities at the working planes of machines periodically. A small portable light meter is all that is necessary.

Another schedule for cleaning fixtures is based on the type of unit and the condition of its reflecting surface. This suggested schedule is as follows:

Type of Unit	Condition	Cleaning Schedule
Direct and Semi-direct	Very dirty	Every week
	Dirty	Every two weeks
	Average	Every month
	Clean	Every two months
Indirect and Semi-indirect	Average	Every two weeks
	Clean	Every month

The cleaning solutions used depends upon the type and condition of the fixture reflecting surface. Where more than one type can be used, the choice generally depends upon past experience. A few of the commonly used cleansers and their application are discussed below.

Soap and water may work well on some types of units. A mild soap and warm water combination is used on reflectors coated with a white casein base paint. When using solutions of this type, care should be exercised to remove all trace of soap film deposits on the lamps and reflecting surfaces.

Chemical detergents, such as commercial forms of trisodium phosphate in a water solution, also work well—especially where dirt and dust deposits are of a greasy consistency.

Green soap solution in alcohol and water are the components of another formula for a cleaning solution frequently used for reflector maintenance.

Liquid wax or wax emulsions can be used as a cleaner. Such emulsions effectively remove the dirt and also leave a thin film of wax on the reflector surface which helps retain the reflectivity of the unit.

For Alzak reflectors cleaning solutions that are free of any alkali should be used. For such equipment it is wise to use the specially prepared cleaners offered by the equipment manufacturers.

Lamp Replacements

Lamp replacements are an integral part of every lighting maintenance program. Here again, the frequency of replacements is a function of several factors—the type of lamp, its rated life, the installation conditions, vibration and atmospheric conditions. Replacement schedules will vary with different plants. Some now in use follow these patterns:

1. *Replacement at Burnout.* This is the most common but not the best practice. It involves considerable waste effort and back-tracking which under present conditions must be reduced to a minimum. The economic value of such a practice is to be seriously questioned.

2. *Replacement at cleaning.* This method has proved much more economical since it ties-in with some multiple of the cleaning periods. Lamps are carefully inspected when the unit is cleaned and, replaced if they are near the end of their rated life. Spare lamps are carried along with the cleaning equipment during maintenance to take care of such replacements.

3. *Group Replacements.* This system, involving the replacement of an entire group of lamps at one time, is being used by many plants today. Cleaning schedules are worked out so the rated life of the lamps end near some multiple of the cleaning periods. The old lamps are usually separated into two groups—one containing lamps near the end of their life; the other containing the few good ones which are set aside for emergency replacements. Such a plan works exceptionally well where voltage conditions and hours of burning are such that almost all lamps in the plant or specific department will reach the end of their rated life at approximately the same time. Advantages of this system include a decrease in the number of burnouts during working hours; decreased lamp replacement labor cost; and a return of the entire production unit to primarily initial lighting efficiency.

GROUND SERVICING of outdoor floodlights or indoor high bay units is permitted by the use of special hanger assemblies that provide for disconnecting and lowering the light unit. A one man crew can do the job.

DISCONNECT HANGERS with plug receptacles permit these mercury vapor units to be taken down for maintenance and repair.

4. *Heavy Duty Lamps* and shock absorbing accessories do much to prolong the life of lamps subject to sustained shock or vibration. Shock absorbers may be external or integral parts of the fixture or hanger assemblies. Vibration on machine mounted lamps can be eliminated by using pedestal mountings or ceiling suspensions.

Maintenance Accessibility

The success of any lighting maintenance program, both from the practical and economic standpoint, hinges on the accessibility of the lighting equipment. A number of aids to maintenance accessibility are outlined below.

1. Fixture Disconnects

The most desirable method of speeding up lighting maintenance is to equip the fixture with some device that permits either the complete unit or just the reflector to be disconnected and taken down.

Integral disconnecting husks incorporated in the fixture assembly permits either the reflector or reflector and socket to be disconnected from the canopy. A number of fluorescent units are designed so the reflectors can be taken down. Thus, spare reflectors can be utilized while the dirty ones are being cleaned in groups.

Exterior disconnecting means permit the entire lighting unit, to be disconnected from the permanent wiring and cleaned, either singly or in predetermined groups. These devices include, among others, suspension chains and hooks; integral cord connector sets which plug into either a receptacle in the branch circuit or on the fixture itself; and detachable trolley assemblies for the flexible systems.

Drop hanger assemblies are frequently used in high bay areas. These assemblies permit the unit to be disconnected from the permanent outlet and lowered by chain or cable for easy floor maintenance.

Lamp and reflector grips are made that facilitate removal of lamps and reflectors from the floor.

2. Maintenance Equipment

The type and quantity of maintenance equipment also varies with each individual plant and its lighting system. Low bay and high bay areas, structural conditions, cranes, monorails are all determining factors.

Step ladders of the ordinary type or specially designed with work platforms to hold the equipment, are used for low bay maintenance.

Portable platforms or towers of the telescoping type are frequently used for maintenance in high bay areas.

Cranes are often used to maintain lighting units mounted over craneways. If the crane is too close to the units, special overhanging platforms are mounted to the crane or to a specially designed light maintenance crane towed by a large unit.

Monorails mounted near the lighting units and equipped with a suspension type cage is another proposed method of servicing high bay lighting.

Service catwalks are frequently installed for maintenance purposes.

Service bridges riding craneways and towed by a crane is used by a large western plane manufacturing plant for servicing and relamping thousands of fluorescent units.

Hand trucks of the four-wheeled type and equipped with several shelves, are often used to distribute the spare fixtures and maintenance material throughout the plant.

Lighting maintenance should not be wholly confined to the fixture alone. The distribution equipment, including feeders, branch circuits, panels and transformers, should be regularly checked. This phase of the program is essentially the same as that recommended for power system maintenance. Voltage and load conditions are vital to efficient lamp and system performance.

Circuit voltage at the outlet should be recorded frequently. Lamps operate most efficiently at their rated voltage. Although overvoltage increases the light output it materially shortens lamp life. Undervoltage operation reduces the light output but will increase the life of the lamps. Maintenance of normal voltage is especially critical to fluorescent lamp systems since voltage dips may cause lamps to go out.

Load conditions bear careful watching. The addition of new units may quickly overload branch circuits to such an extent that light output and production might suffer.

A maintenance system without a well stocked spare parts department is like a service station without gasoline. Service just can't be rendered unless the tools and equipment are readily available for emergencies.

Among the lighting maintenance items that should be stocked in reasonable quantity are:

1. Spare lighting units—quantity depends on the extent of the system.
2. Spare lamps—type and number depend on the type and size of the lighting installation.
3. Spare lampholders, reflectors, auxiliary units, starters and other accessories.
4. A reasonable number of spare lighting transformers.

A highly organized systematic program of lighting maintenance pays dividends at all times. Its importance under wartime conditions cannot be underestimated. Our problem today is to increase production and make the most of what we have since new equipment is scarce and closely allocated. Maintenance helps us gain these ends. It should be made an integral function of every plant operating schedule.

SOAP AND WATER are the basic tools for this important part of maintaining good lighting conditions. A good cleaning can improve lighting levels 30 percent or more in dust laden areas.

ON the following pages you will find the advertisements of 40 leading manufacturers of lighting fixtures, lamps and tubes, and many accessories.

These advertisers are glad to place their products and their personnel at the service of our readers, within the limits imposed by recognized priority restrictions.

Particularly in these critical times, we recommend that each reader look to these ads as sources of the latest possible information about products and services.

★ ★ ★

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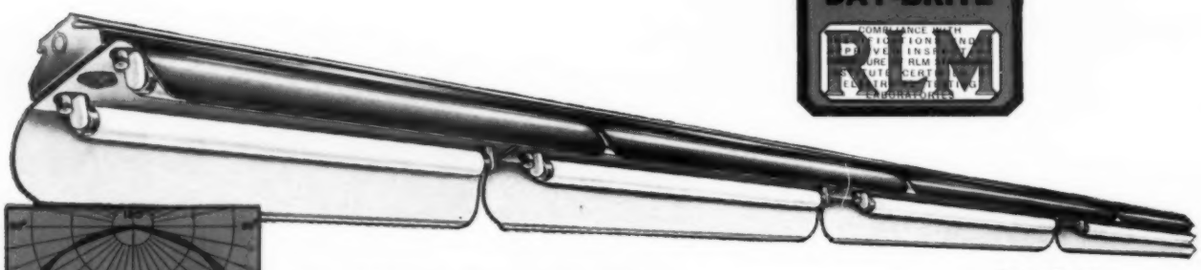
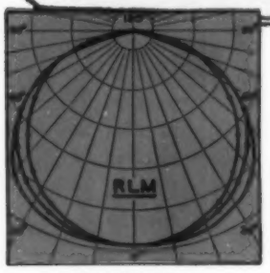
A NEW PRIORITY SERVICE to

TO GET ACTION, to Save Time for You, Your Customers and the WPB — Day-Brite offers you four accurate sources of quick help in supplying all data required to properly fill out PD-1A forms for Fluorescent Fixtures: (1) Your Day-Brite Distributor . . . (2) Your local Day-Brite Representative . . . (3) Your Complete Day-Brite Catalog . . . (4) Day-Brite Executive Offices . . . USE THIS 4-WAY HELP — ANYTIME — ON ANY JOB REQUIRING A PD-1A!



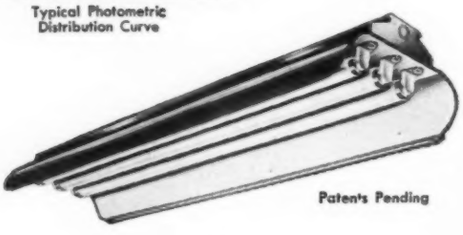
Patents Pending



Typical Photometric Distribution Curve

The DAY-LINE . . . CONTINUOUS

For Industrial Applications . . . Provides a flexible method for installing long, unbroken lines of luminaires. Foot-candle intensity can be easily varied to suit specific conditions. Continuous wiring housed in the same channel with ballasts, sockets and lamp starters. Removable reflectors. For complete data, see Bulletin No. F-60.

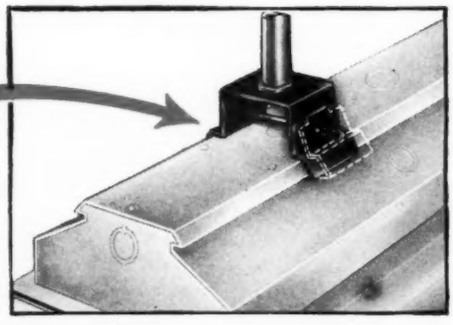


Patents Pending

The DAY-LINE UNIT

For Industrial Applications . . . The same construction as used in the DAYLINE. Can be easily installed as a unit for localized lighting or in parallel batteries to produce a blanket or spread of high-intensity illumination. Removable reflectors. For complete data, see Bulletin No. F-60.

EASY TO HANG with



"ICE-TONG" HANGER CLAMPS

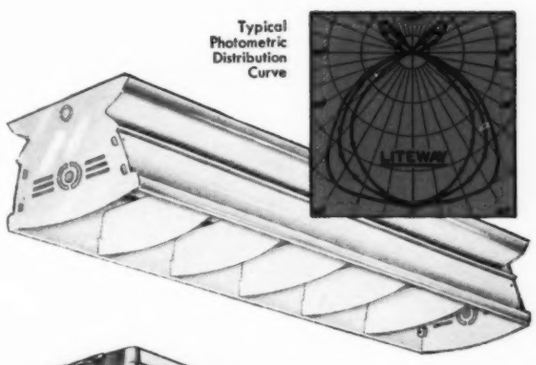
It is unnecessary to "spot" exact locations for mounting hangers or conduit when using these exclusive Day-Brite "ice-tong" hanger clamps. They can be positioned at any point in the entire length of the unit or continuous fixture and are permanently held by turning down one screw.

DAY-BRITE LIGHTING, INC., 5440 BULWER AVE., ST. LOUIS, MO.

CONTRACTORS . . . DEALERS

Consult this ready reference table and guide . . . It gives you a quick view of basic data on the Day-Brite Fluorescent Fixtures illustrated and described on these pages.

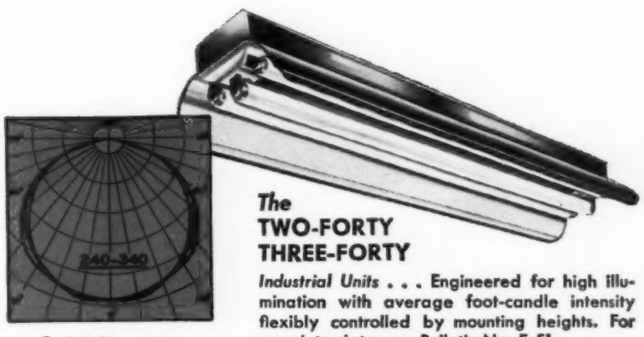
Name of Fixture	For Lamps	Application	Suspension	Bulletin Ref. No.
DAYLINE CONTINUOUS	2–40w, 3–40w, 2–100w	Continuous	Chain, stem, cable or direct	F-60
DAYLINE UNITS	2–40w, 3–40w, 2–100w	Units	Chain or conduit	F-60
TWO–40 and THREE–40	2-40w and 3–40w	Units	Chain or conduit	F-51
PARALUME	2–20w, 3–20w, 4–20w, 2–40w, 3–40w, 4–40w	Units and continuous	Ceiling or suspension	F-50
LITEWAY	1–40w, 2–40w, 1–100w	Units and continuous	Ceiling or suspension	ADS-502
KINGSWAY	2–20w, 3–20w, 4–30w, 6–30w, 2–40w, 3–40w, 4–40w, 6–40w	Units and continuous	Direct mounting only	F-48



Typical Photometric Distribution Curve

The LITEWAY

For Engineering, General Office and Drafting Room Use . . . Removable louver type exposed troffer for direct ceiling mounting in single units or long continuous runs. Side openings provide ceiling light, increasing over-all efficiency. For complete data, see Bulletin No. ADS-502.



Typical Photometric Distribution Curve

The TWO-FORTY THREE-FORTY

Industrial Units . . . Engineered for high illumination with average foot-candle intensity flexibly controlled by mounting heights. For complete data, see Bulletin No. F-51.

Typical Photometric Distribution Curve

The PARALUME

A General Purpose Fixture of the exposed tube type . . . Provides smooth, efficient over-all illumination. For complete data, see Bulletin No. F-50.

Typical Photometric Distribution Curve

The KINGSWAY

For Administration Areas . . . Specifically designed for direct ceiling mounting. A well diffused unit using fluted glass cylinder enclosures. For complete data, see Bulletin No. F-48.

DayBrite Rivals Daylight — Adds Victory Hours!

Patents Nos. 130,740, 2,281,346, 122,156, 125,001, 125,751

52

Day Brite FLUORESCENT FIXTURES

The COMPLETE LINE OF FLUORESCENT LIGHTING FIXTURES *Nationally distributed through all leading electrical supply houses*

SAVES BRASS

FOR

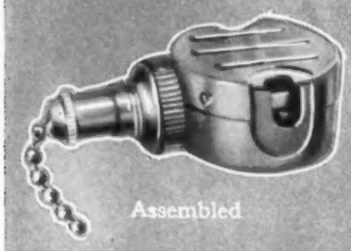
3,800,000

.30 Caliber

SHELLS

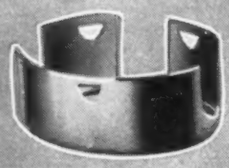
Levolier

Old No. 41 Switch



Assembled

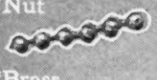
*Brass Cap



*Brass Shell

*Brass Lever

*Brass Nut

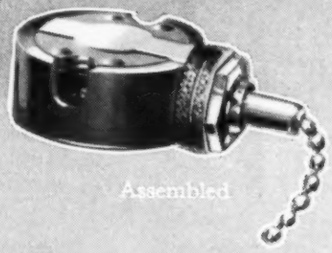


*Brass Pull Chain

*Eliminated to Save essential Brass

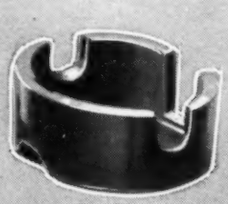
Levolier

New No. 41-B Switch



Assembled

(No Cap Needed)



Plastic Shell•

Steel Lever•

Steel Nut•

Steel Pull Chain•

•Plastic and Steel displaces Brass

From Levolier switches to .30 caliber shells goes the brass that formerly was used in making the famous McGILL No. 41 Levolier switches. The savings effected in eliminating brass from the annual output of these switches will save enough of the critical material to produce three million, eight-hundred-thousand of .30 caliber shells.

In making the change McGILL engineers have developed a plastic casing that is practical, sturdy, light in weight, easy to wire and embodying all the compact efficiency of the former brass-cased switch. Other new parts include a steel lever, nut and steel chain in place of brass. The casing cap has been eliminated facilitating assembly of the switch.

ELECTRICAL DIVISION

McGILL MANUFACTURING COMPANY, Valparaiso, Indiana

McGILL *Levolier* SWITCHES

YOU CAN HELP WIN THE WAR BY SMASHING LIGHTING BOTTLENECKS!

☆ ☆ ☆

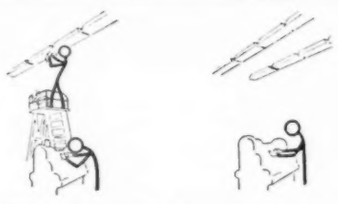
Getting the right light in the right plants at the right time can help win the war. This places a big responsibility on the whole lighting industry. Who's going to do the job? One thing we as the lighting industry *can* do, with our knowledge of how proper lighting can increase production, is to step up our tempo of customer contact and service.

Another is to seek out all plants, large and small, who are faced with the problem of extra shifts, and make sure we are helping plant management remove all the bottlenecks that occur from improper lighting. (A few of these bottlenecks are indicated below.)

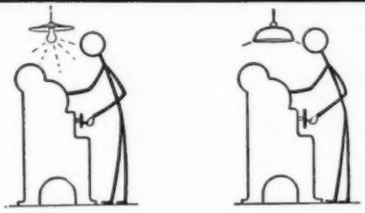
Another thing we can do is to organize in each community to see that every available man in the lighting industry knows how to prescribe light for increased production and is out doing it every day!

To help electrical contractors do these jobs, the G-E Lamp Department offers its available manpower—backed by a wealth of specific suggestions. Included in this material is a condensed 268-page pocket-size book containing before-and-after photos of 24 lighting bottlenecks and how to break them, as well as valuable lighting data. Price $1. See your G-E Lamp Division or write General Electric Co., Dept. 166-EC-7, Nela Park, Cleveland, O.

BETTER LIGHT CAN BREAK PRODUCTION BOTTLENECKS LIKE THESE



DIRT, as you know, is the commonest of all lighting bottlenecks and the easiest to cure. Have you taken the trouble to tell customers that simply cleaning lamps, fixtures and windows regularly with soap and water can increase light 50%?

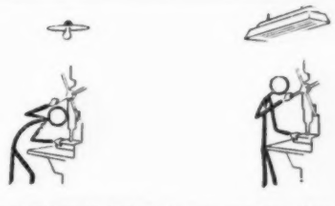


DIRECT GLARE is a bad bottleneck because it means too much light in a worker's eyes, too little on his work. You can do a "first aid" job for many of your customers by a few simple things to break this bottleneck and save up to 50% of light.

REFLECTED GLARE is often worse than direct glare. This should be a red flag to you to relocate supplementary lighting units, change equipment that diffuses light poorly, or change from concentrated light sources to large area sources.

INTERFERING SHADOWS caused by "standing in your own light" or working in the shadow of shop machinery. If you can't install adequate general lighting, at least you owe it to your customer to increase the number of light sources so far as possible.

SHARP CONTRASTS caused by poor illumination on charts, blueprints, diagrams, etc. Eyes shifting continuously from bright illumination on job to lower intensity on chart, tire rapidly. Cure is, of course, to equalize lighting.



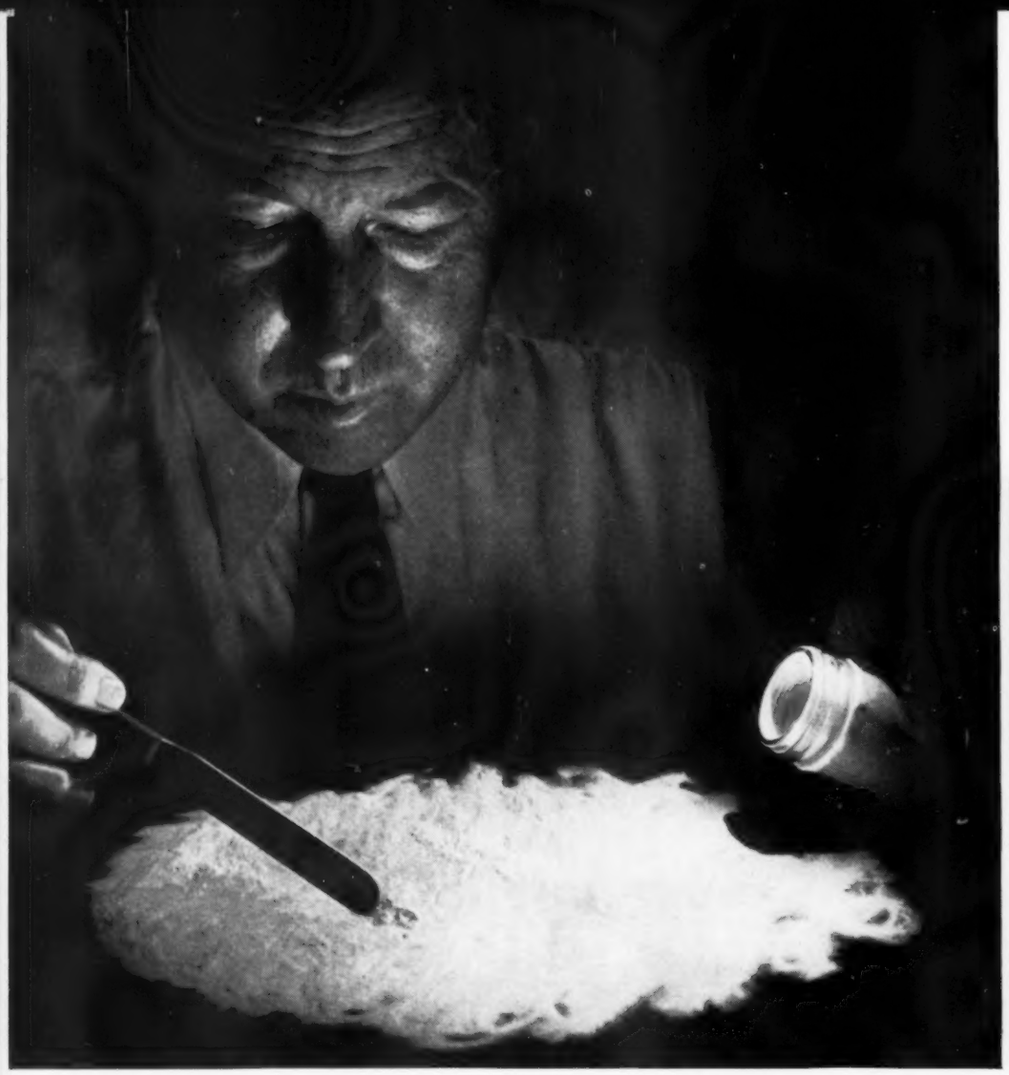
NOT ENOUGH LIGHT to see quickly. Customers frequently don't realize it takes time to see. Tell them that good light helps them do the job faster because moving objects are seen more clearly when better light is provided.

G-E MAZDA LAMPS

GENERAL ELECTRIC

See next page

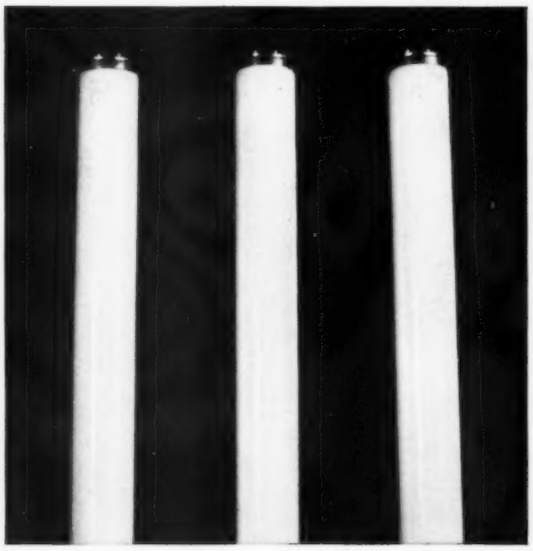
Why
'stay



1 DR. W. A. ROBERTS OF G-E LAMP DEVELOPMENT LABORATORY is studying the synthetic phosphors used in coating G-E MAZDA Fluorescent lamps to make them *stay brighter longer*. Up to June 1, General Electric had put approximately 450,000 man-hours of research into Fluorescent lamp improvements with the objective of giving the user more and more light for less and less cost.

2 MAXIMUM LIGHT OUTPUT and better appearance are results of smoother, more uniform phosphor coating of correct thickness, constantly checked by the test this young lady is making.

6 GREATER UNIFORMITY AND DEPENDABILITY are assured by constant inspections. These girls are inspecting lamps during the "seasoning" process.



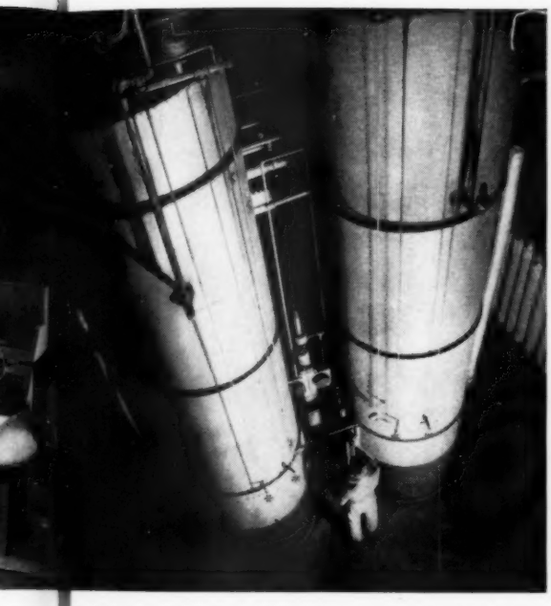
7 UNRETOUCHED PHOTO of 3 40-watt G-E MAZDA F lamps. One is new, second has burned 2030 hours, third has burned 2650 hrs. (150 hrs. over rated life). Note absence of end-blackening.

8 GREATER COLOR UNIFORMITY is assured when controlled and checked by "electric eyes" with color filters . . . one of many routine checks in G-E's Fluorescent lamp factories.

G-E MAZDA LAMPS

y G-E Fluorescent Lamps
y brighter longer'

YOUR CUSTOMERS WANT as much light for their money as they can get . . . to help speed war production, reduce waste, and avoid accidents. Here are just a few of the reasons G-E MAZDA F lamps are better today than ever before—why they give such dependable service—why they stay brighter longer.



appear-
e uniform
constantly
king.

3 MORE UNIFORM, EASIER STARTING results from exact pressure control of argon gas. Dryer, purer argon means better lamps. In these tanks, moisture is removed from argon by freezing at -304°F.

4 A TINY DROP OF MERCURY like this is accurately measured and safely injected into G-E MAZDA F lamps by automatic machines specially designed by G-E engineers. Results: lower cost, better operation.

5 STRAIGHT LAMPS and proper socket fit are assured when machine-drawn glass tubes, cut to precise lengths, are hot-rolled on this machine.

ed when
yes" with
checks in

9 MORE LIGHT for current consumed. This device tests brightness of the phosphors used in G-E MAZDA F lamps—an important factor in lamp uniformity and efficiency.

10 RUGGEDNESS OF G-E MAZDA F lamps is further assured by the "twist test" in which 20 pounds of torsion pressure per square inch is applied to base, pins, and tubes.

11 SELL YOUR CUSTOMERS lamps with the G-E monogram . . . the kind that *stay brighter longer*. For best results urge them to use certified lighting equipment.

PS

GENERAL ELECTRIC

FOR BEST PERFORMANCE IN FLUORESCENT LIGHTING FOR LEAST MAINTENANCE

Begin with a Good Ballast

G-E Tulamp ballast for 40-watt lamps

CHOOSE G-E . . . BECAUSE

1. You get full lamp efficiency

2. You benefit from our testing plan

FLUORESCENT-LAMP performance depends largely on proper electrical characteristics of the ballasts. Poor ballasts may cause failure of lamps to start, early end-blackening, shorter lamp life, less light for your dollar.

To make sure that G-E ballasts have uniformly good characteristics we wind coils on automatic machines, silver-solder all connections, machine-assemble cores and coils, and employ other advanced manufacturing methods. All materials that go into G-E ballasts are carefully selected for high quality. Every step in manufacturing is checked by experienced testers and inspectors. The completed product, depending on design, is given seven to ten tests to assure excellence.

Saving with Tulamp Ballasts

For most installations, G-E Tulamp ballasts, which have a power factor of 95 per cent or above, are the most economical. Wiring costs are less with high-power-factor ballasts because more lamps can be supplied from the same sized feeder. Ballast electrical losses are also reduced materially, which gives savings in operating costs.

We make a ballast for every need, from 4 watts to 100 watts. Write today for Bulletin GEA-3293C. It describes the complete range of G-E ballasts and also gives valuable tips on installation and operation. *General Electric, Schenectady, N. Y.*

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC

408-4-5205

"Without exception, the properly designed starter can contribute more to the useful life of the Fluorescent lamp than any other accessory."

RIGID tests on delicate instruments such as the cathode-ray oscillograph have definitely proved that G-E Starters are properly designed to prolong the life of your fluorescent lamps and give more economical fluorescent lighting. For instance:

In all G-E Starters, preheating of the lamp electrodes is accurately timed to start the lamp at the right moment — not before, not after. This accurate timing conserves lamp emission material (vital to long lamp life).

In all G-E Starters, the constant breakdown voltage is maintained throughout the life of the starter at a point where it will not interfere with good lamp operation. Again, lamp life is prolonged through proper design.

It's not surprising, then, that enthusiastic users everywhere ask for G-E Starters when they want the best performance from their fluorescent lighting equipment.

WHEN BUYING FLUORESCENT FIXTURES—Insist that your fixtures have certified G-E equipment consisting of G-E Starters and Rotating Lock Lampholders, G-E Mazda F Lamps, and G-E Ballasts. It's the best way to buy "protection" for your fluorescent lighting equipment.

APPLIANCE AND MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

GENERAL ELECTRIC

"And I'm protecting my fluorescent lighting with G-E Wiring Materials"

AVAILABLE ON PRIORITY BASIS

G-E Wiring Materials are high quality and give uninterrupted service. The line includes all of the wiring materials needed to serve fluorescent lighting. There's a distributor handling them right in my own territory. (G-E Wiring Materials Distributors are located at key points all over the country.) That's why I chose G-E Materials to serve my fluorescent lighting.

G-E CONDUIT PRODUCTS

G-E Conduit Products include G-E Black enamelled conduit, G-E White hot-dipped galvanized zinc-coated conduit, E.M.T., flexible conduit, G-E Fiberduct, BX and BraidX. They are carefully made quality materials. I adopted G-E Black conduit to carry the wires serving my fluorescent lighting because using it saves zinc for the war effort.

G-E WIRE AND CABLE

I found different grades of building wire to meet different conditions—Type R, Code Grade; Type RP, Performance Grade; Type RH, Heat Resistant Grade; Type RW, Moisture Resistant Grade—all high quality materials. There are also different fixture wires including rubber insulated and Deltabeston asbestos insulated.

G-E WIRING DEVICES

There are literally hundreds of G-E Wiring Devices — fluorescent lampholders and starters, switches, branch-circuit circuit breakers, fuses, convenience outlets, plates, etc. I particularly like G-E No-Blink fluorescent starters because they automatically "cut out" dead lamps and extend the useful life of the starters.

For further information on G-E Wiring Materials to serve fluorescent lighting or for information on wiring materials for any other purpose, see the nearest G-E Merchandise Distributor or write to Section CDW-7211-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

EYES
EFFICIENT
EVERYWHERE

Man's mightiest machine is the human eye. Eyes perform at peak efficiency only under ideal lighting conditions. To provide that lighting so vital to America's war effort, GESCO field forces are ready for action on minutes' notice in every major industrial sector on this map.

LIGHTING'S "COMMANDOS"...at your command!

GOOD LIGHTING will help win this war . . . if every war plant has the *right* lighting. That's an individual problem dependent upon individual conditions, and demanding *personal* attention.

All the helpful lighting data published is enormously valuable. But get down to cases, and it is face-to-face discussion between the man with the problem, and the man trained to interpret this lighting material, that provides the most speedy and satisfactory solution.

Case after case in the GESCO files shows this is so.

GESCO has a corps of trained lighting men strategically spotted at 95 supply centers from coast to coast. Men on their toes to work closely with contractors, utilities and industry with prompt, on-the-scene service. Three-way service, in fact . . . *service in supplies, service in engineering,* and *service in priority counsel.*

These GESCO specialists are lighting's "Commandos," set to spring into action at your command, day or night . . . to lick current problems, to anticipate coming ones. They will help you use lighting to make EYES EFFICIENT EVERYWHERE . . . to speed war production, to beckon Victory.

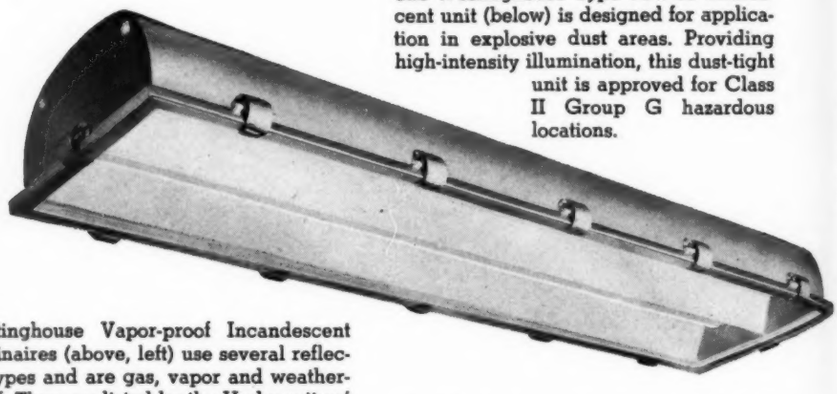
GENERAL ELECTRIC SUPPLY CORPORATION

GENERAL OFFICES BRIDGEPORT, CONNECTICUT

A complete lighting service, backed by all departments of the General Electric Co., plus the full facilities of leading equipment manufacturers—The Miller Co., Holophane Co., Curtis Lighting, Inc., DayBrite Lighting, Inc., Mitchell Manufacturing Co., and others.

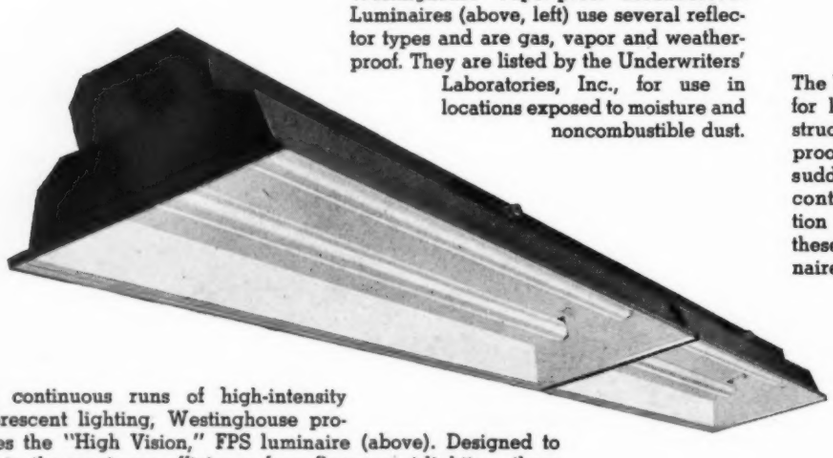
engineered seeing

Engineered seeing **for the nation's industrial soldiers is helping produce more weapons, *faster,* for the men on the firing line. *Engineered seeing* is illumination created by scientifically designed lighting equipment, expertly applied to achieve the best possible visibility conditions.**



The Westinghouse Type FDT-40 fluorescent unit (below) is designed for application in explosive dust areas. Providing high-intensity illumination, this dust-tight unit is approved for Class II Group G hazardous locations.

Westinghouse Vapor-proof Incandescent Luminaires (above, left) use several reflector types and are gas, vapor and weatherproof. They are listed by the Underwriters' Laboratories, Inc., for use in locations exposed to moisture and noncombustible dust.



For continuous runs of high-intensity fluorescent lighting, Westinghouse provides the "High Vision," FPS luminaire (above). Designed to obtain the maximum efficiency from fluorescent lighting, these units use two or three 40-watt lamps; and the porcelain enameled reflectors may be extended end-to-end as far as desired.

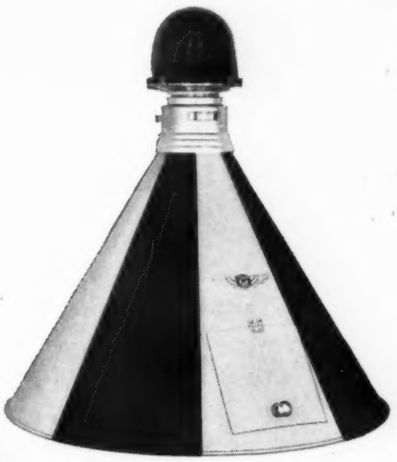
The Westinghouse Millite (below) is built for heavy service industries. It is constructed of sheet steel and has a shatterproof glass cover which is unaffected by sudden temperature changes. Efficient, controlled illumination is provided by these high-bay luminaires.

WESTINGHOUSE

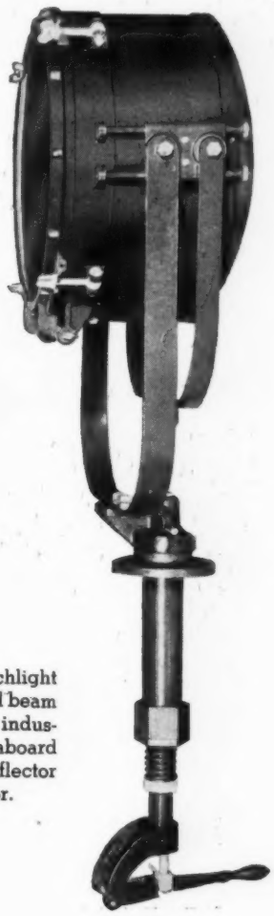
Westinghouse

serves the war front

The new MF-180 Fresnel luminaire (left) is designed for protective lighting along fence lines and walls. The MF-180 unit has a porcelain reflector and a fresnel lens.



As part of a complete line of airfield lighting equipment, the Westinghouse Boundary Cone, with red globe, is used to mark hazardous approaches (above).



The Westinghouse 18-inch Searchlight (right), providing a concentrated beam over great distances, is used at industrial plants, public utilities and aboard ships. It has a primary glass reflector and a secondary metal reflector.

The new EH and EHG floodlights (right) have been designed for lighting fence lines and plant buildings. They use universal burning lamps and have hinged cover doors. EHG units are furnished with narrow-beam reflectors (metal-backed glass) and EH units with wide-beam reflectors (porcelain enameled).

At our Lighting Division, today, we are producing luminaires for all types of industrial operations; aviation lighting equipment; and floodlights, searchlights and lighting units for night-time protection against sabotage.

Information is available on all Westinghouse lighting fixtures available for war industries. Our lighting specialists will gladly help you complete priority lighting questionnaires. This counsel is available through 117 Westinghouse Electric Supply Company Offices and Independent Distributors.

your planning book . . . free

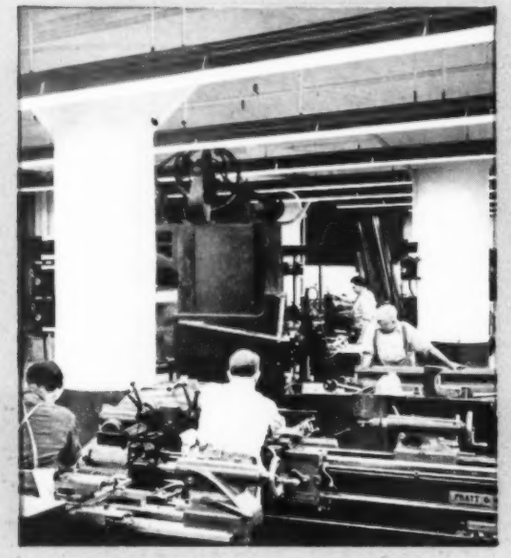
Westinghouse lighting engineers have prepared this brand-new *Protection and Production with Light—Planning Book.* With full application details, the book is yours for the asking. Just write Westinghouse Electric & Mfg. Co., Edgewater Park, Cleveland, Ohio.

Lighting Equipment

Lighting is an essential war material

Westinghouse

HELPS YOUR CUSTOMERS MAKE THE MOST OF IT



Until the war is won, our first job is to supply the Mazda Lamps that keep the nation's factories and mills bright with light 24 hours a day.

Present installations must be re-checked, improved, properly maintained. Installations must be engineered and installed to provide the kind of light that helps men work better and faster, with less fatigue, and fewer errors.

Westinghouse efforts, for the duration, are directed to installations where lighting increases production, and in the maintenance of present fluorescent installations at peak efficiency.

LET'S SEE TO IT THAT GOOD LIGHTING DOES ITS PART TO WIN THE WAR

We can help our nation's war program by helping every vital plant, every vital business make the best use of lighting. Good lighting helps speed production by enabling workers to see more easily. Good lighting helps build employe morale. Good lighting helps reduce fatigue and mistakes. Telling the nation's production men these advantages is our obligation. Getting our plants and factories to enlist the services of better lighting is what we can do in '42. Westinghouse Electric and Manufacturing Co., Lamp Division, Bloomfield, N. J.

Westinghouse

MAZDA FLUORESCENT LAMPS

A little attention brings out the good qualities underneath.
A little soap and water can do wonders
for a plant's lighting efficiency

The grime that gathers on light reflectors can play havoc with the efficiency of your lighting system. But, if Alzak* Aluminum Reflectors are on the job, it's no trick to restore their original high reflectivity.

An occasional dusting with a dry cloth may be all that Alzak Reflectors require for maintenance. Or, if they're working out-of-doors or where fumes are in the air, they may need washing with a mild soap and water. They may even need a different treatment where conditions are severe.

The Alumilite finish (process patented) gives the reflector a hard and tarnish-resistant surface. That's why the original high efficiency of your lighting system is easy to maintain when you're using Alzak Aluminum Reflectors.

If you want help on this subject, send for the booklet, "Instructions for the Protection and Maintenance of Alumilite Finishes and Alzak Reflectors." Write ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh, Pa.

*Registered Trademark

ALCOA ALUMINUM

Preview

A NON-METALLIC REFLECTOR UNIT for WAR PRODUCTION INDUSTRIES

Preview of. . . the non-metallic reflector fluorescent industrial lighting unit, designed in anticipation of further limitations on the use of steel.

This new Curtis development is arranged for use in long continuous runs or as individual units. This fixture will be available for forty watt or one hundred watt fluorescent lamps.

The backbone of the fixture is CurtiStrip which provides rigidity and ample wiring capacity. Ballasts and starters are mounted on top of this channel and the non-metallic reflector is supported below it.

Best of all, the new units will have the same Fluracite reflecting surface we are now using on our steel reflectors. This reflecting surface is remarkable for its high efficiency and durability and has been tested by 3½ years service on Curtis quality products.

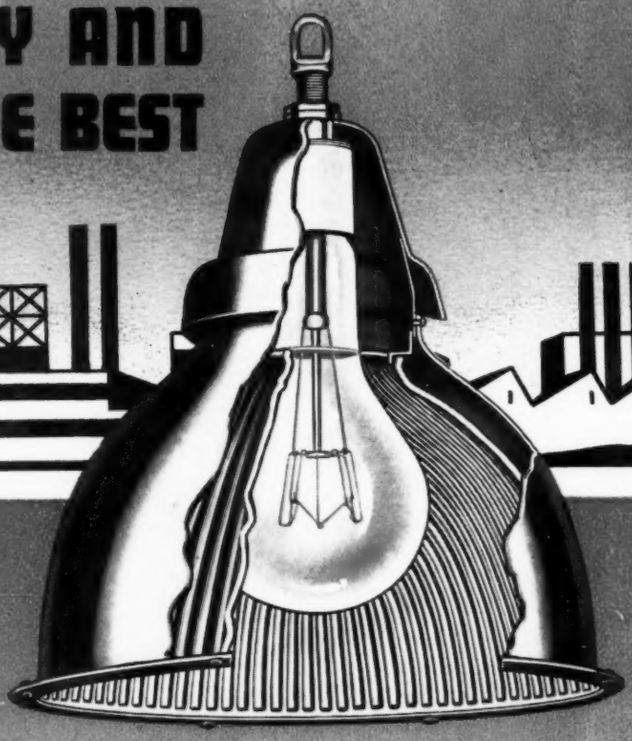
****

Write us or get in touch with your local Curtis representative for further information.

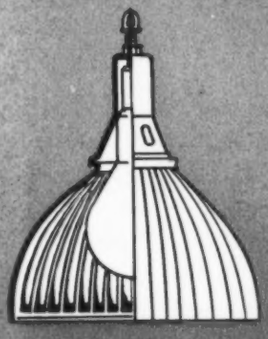
CURTIS LIGHTING, INC.

6135 W. 65TH STREET . . . . CHICAGO

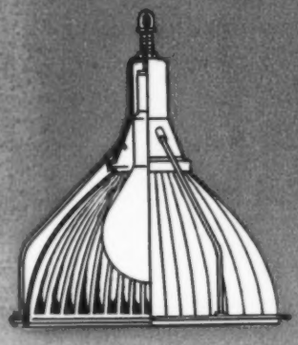
WHEN YOUR PD-1A FORM DESCRIBES *Curtis* EQUIPMENT SOMEBODY KNOWS QUALITY AND HAS SPECIFIED THE BEST



You can't go wrong if you specify Curtis on those war industry lighting projects for all defense plant lighting needs, including office lighting.



CAT. NO. 589



CAT. NO. 589-T

X-RAY SILVER MIRROR GLASS REFLECTORS

"X-Ray" reflectors have been the recognized standard of excellence for incandescent lighting from high bays for many years, but the No. 1589 reflector unit illustrated above is brand new.

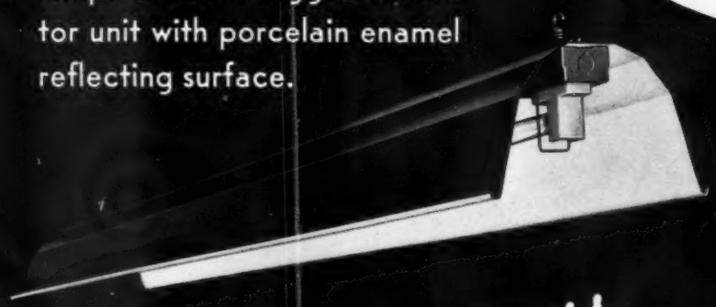
It is for 750, 1000, or 1500 watt P.S. lamps, and consists of a new and efficient reflector design (No. 589) in a metal housing.

Two other units using the same reflector are also available. No. 589 reflector unit which consists of the silvered glass reflector with vibration-proof holder and socket, and No. 589-T which is similar to No. 589, but has a tripod holder and cast retaining ring at the bottom of the reflector. Where a metal housing is not required, No. 589 is particularly to be recommended since it uses very little scarce material.

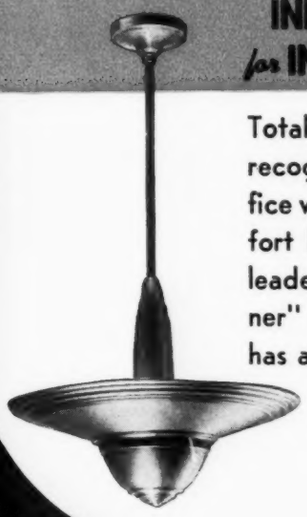
3 KW MERCURY LAMP INDUSTRIAL UNIT

This new unit is "tops" for industrial lighting for high bays. In most cases one unit to the bay will be sufficient. Fewer units mean low maintenance and installation costs.

Curtis Catalog No. 1570: for 3 KW Mazda AH-9 (Mercury) lamp. Efficient rugged reflector unit with porcelain enamel reflecting surface.



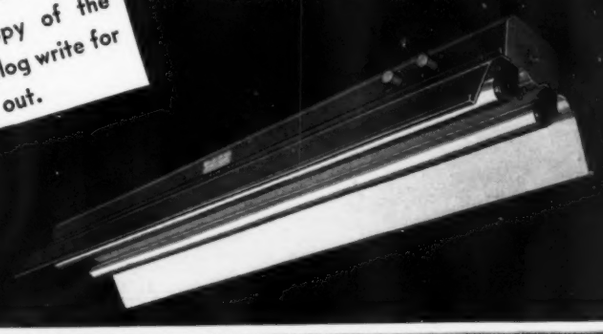
INDIRECT LIGHTING for INDUSTRIAL OFFICES



Totally indirect lighting is recognized as ideal for office work. Curtis Eye Comfort luminaires are the leaders in this field. "Winner" luminaire illustrated has an "X-Ray" Silver Mirror Reflector concealed in the bowl.

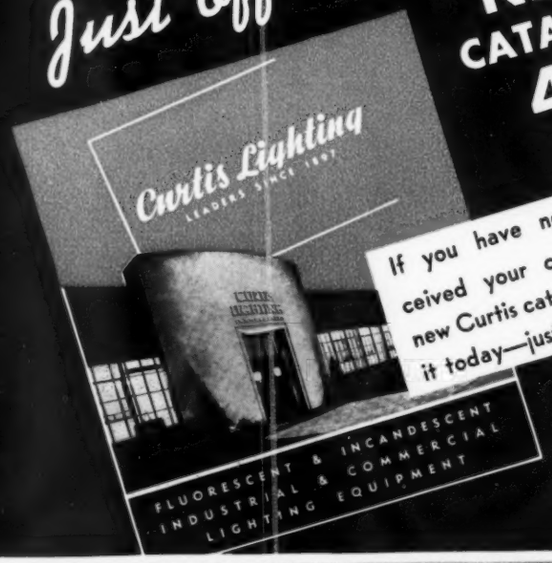
TWO LAMP FLUORESCENT INDUSTRIAL UNITS

Intended for general and local factory lighting, Cat. No. 1540-Z is for 2 40-watt lamps. Catalog No. 1550-Z for 2 100-watt lamps. Both units have Fluracite reflecting surface, which is a baked white synthetic finish of exceptionally high efficiency developed and guaranteed by Curtis.



Just off the Press

NEW CATALOG 42



If you have not yet received your copy of the new Curtis catalog write for it today—just out.

CURTIS LIGHTING, INC.

6135 WEST 65TH STREET - - - - CHICAGO

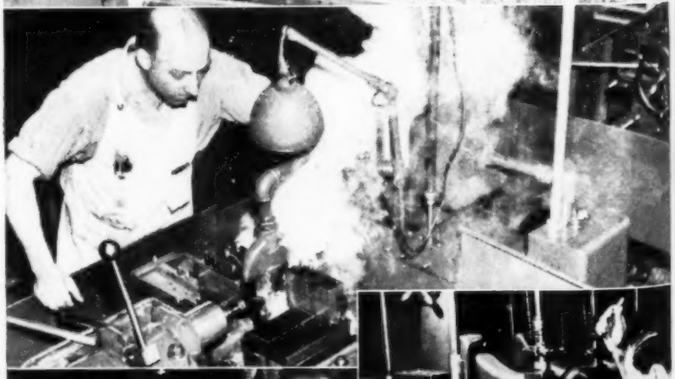
Speed up War Production—

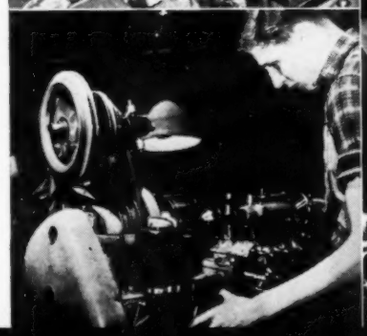
CONVERT TO "

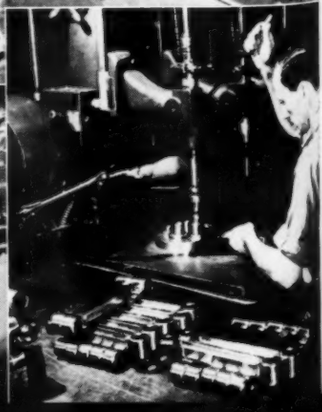
FOR MAXIMUM "SEEING" E

BALANCED fostoria LIGHTING

FOR BETTER SEEING IN INDUSTRY







Just What Is Balanced Lighting?

Today, in industrial practice, the experienced illumination engineer studies the lighting requirements for each worker's task. He seeks to fit lighting to the job. He determines the quality, quantity and distribution of lighting needed for most efficient seeing on individual work areas. He then obtains the proper balance of needed footcandles on the job with footcandles beyond the work area by combination of localized lighting with general lighting.

By general lighting, illumination is spread horizontally in a general way over the entire work room. Its proper purpose is "back-ground" lighting.

By localized lighting, illumination of needed intensity is concentrated directly on the worker's task. Its purpose is "close-up" lighting easily adjustable to individual requirements.

Both "background" and "close-up" lighting are vital to efficient seeing. When the right amount of both types is employed, the result is Balanced Lighting — the properly engineered illumination for maximum efficiency, comfort and economy.

War Industries Find Balanced Lighting Big Aid To Increase Production

In thousands of plants now converted to war production, employers recognizing the quick advantages to be gained in production speed and worker morale, have invested in Balanced Lighting as provided by Fostoria. There is no tool more vital to workmen and the production drive for war goods than "better seeing on the job."

Fostoria — The Only Equipment Line For Balanced Lighting In Industry

General illumination is best provided in most industrial plants by lighting units employing fluorescent lamps such as available in the Fostoria Generalite line.

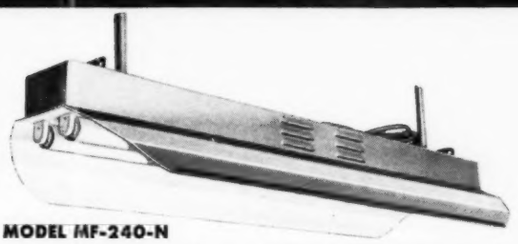
Localized illumination for application to the needs of individual workers must possess the range and flexibility as provided by Fostoria Localite units.

The following page pictures and describes Fostoria Generalites and Localites now in popular demand throughout industry. Use this information in filling out and submitting PD-1A forms to the War Production Board to obtain priority rating.

"BALANCED LIGHTING"

EFFICIENCY ON EACH WORKER'S JOB

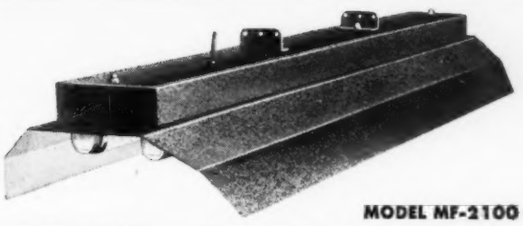
GENERALITE fostoria for Background Lighting



MODEL MF-240-N

OPERATING CHARACTERISTICS — Model MF-240-N is designed for instantaneous starting, turning on and off instantly like an incandescent light. NO STARTING SWITCHES REQUIRED. Constructed to reduce noise, radio interference and stroboscopic effect to a minimum.

SPECIFICATIONS — Open end fluorescent Generalite designed with instantaneous starting for 2 or 3 40W lamps. Reflector: overall length 49", depth 4", width 13", cut-off angle 13°. Lamp sockets for 2 lamp installation on 5" centers. Reflecting surface, baked Gloss White, mar-proof enamel. Outside surface, Cloud Gray baked enamel. Model designed for both chain or conduit mounting with all electrical parts contained in housing. Reflector detachable for efficient, economical maintenance. Available for 110 volt, 60 cycle, A. C. circuit. High power factor. Carries Underwriters Re-examination Label.



MODEL MF-2100

SPECIFICATIONS — Open end fluorescent Generalite designed with starting switches for 2 or 3 40W lamps. Reflector: overall length 63", depth 5¼", width 16", cut-off angle 14°. Lamp sockets for 2 lamp installation on 5" centers. Reflecting surface, baked Gloss White, mar-proof enamel. Outside finish Cloud Gray baked enamel. Model designed for both chain or conduit mounting with all electrical parts contained in housing. Reflector detachable for efficient, economical maintenance. Available for 110 volt, 60 cycle, A. C. circuit. High power factor. Carries Underwriters Re-examination Label.

LOCALITE fostoria for Light ON the Job

All Fostoria Localites are equipped with flexible arms employing friction grip ball and socket joints which provide ample rigidity to withstand shock and vibration. Instantly adjustable to any position desired without tightening or loosening joints.

REFLECTORS ARE WELDED TO THE ARMS as an integral part. This eliminates screwing or clamping reflector to socket, preventing strain on the socket which would cause loosening and separation.

A variety of base attachments are available for installation as required.

MODEL 3267-FXM-102

Designed to provide 50 foot candles on work area 24" x 40". Reflector accommodates one 15 watt fluorescent lamp. Double flexible joint supporting arm is 21" long. Complete with sockets, wiring, ballast and manual switch. Inside reflector finish Gloss White baked enamel. Outside finish, Wrinkled Gray baked enamel. Available for 110 volt, 60 cycle, A. C. circuit. Low power factor.

MODEL 3267-H-102

Designed to provide 200 foot candles covering 20"x16" work area 12" from reflector. Accommodates one 75 watt medium base incandescent lamp. Double flexible joint supporting area is 21" long. Overall length 32½". Inside reflector finish Gloss White baked enamel. Outside finish, Wrinkle Gray baked enamel. Complete with socket, wiring and plug.

MODEL 3470-P-104

Designed to provide 300 foot candles over 28" circle work area 12" from reflector. Accommodates one 100 watt medium base incandescent lamp. Double flexible joint supporting arm is 32" long. Overall length 46". Inside reflector finish Gloss White baked enamel. Outside finish, Wrinkle Gray baked enamel. Complete with socket, wiring and plug.

MODEL 3267-C-104

Designed to provide 135 foot candles over 20" circle work area 12" from reflector. Accommodates one 60 watt medium base incandescent lamp. Double flexible joint supporting arm is 21" long. Overall length 33". Inside reflector finish Gloss White baked enamel. Outside finish Wrinkle Gray baked enamel. Complete with socket, wiring and plug.

THE FOSTORIA PRESSED STEEL CORPORATION, FOSTORIA, OHIO

Fostoria Products Manufactured and Distributed in Canada by Amalgamated Electric Corp., Ltd., Toronto, Canada

For Counsel on Lighting Problems

CALL OR WRITE YOUR NEAREST FOSTORIA INDUSTRIAL SERVICE STATION

ATLANTA, GA.
The John A. Dodd Company
299 Techwood Dr., N.W. Phone: Jackson 1695

BALA-CYNWYD, PA.
The J. V. Calhoun Company
349 Montgomery Ave.
Phone: Greenwood 4477 at Phila.

BIRMINGHAM, ALA.
National Distributors, Inc.
1925 Fifth Ave., N. . . . Phone: 3-6259, 3-6250

BOSTON, MASS.
Fostoria Engineering Service
(Div. of Copley Sales Co.)
620 Commonwealth Ave., Phone: Com. 0333

BRIDGEPORT, CONN.
Sprague Electrical Supplies, Inc.
777 Main Street . . . . . Phone: 4-2141

BUFFALO, N. Y.
Fostoria Industrial Service
(Div. of Wipperman & Mitchell, Inc.)
404 N. Oak St. . . . . Phone: Lafayette 8135

CHARLESTON, W. VA.
Charleston Electrical Supply Company
Phone: 26-157

CHARLOTTE, N. C.
Mill Power Supply Company
300 W. 1st St. . . . . Phone: 6134-6137

CHATTANOOGA, TENN.
Harry W. Cameron, Inc.
1021 Chestnut St. . . . . Phone: 6-6194-5

CHICAGO, ILL.
Fostoria Industrial Service
(Div. of Hyre Electric Co.)
741 W. Jackson Blvd. Phone: Haym'k't 8130

CINCINNATI, OHIO
Fostoria Industrial Service
(Div. of Harrison Tire & Rubber Co.)
Court & Race Sts. . . . . Phone: Parkway 2080

CLEVELAND, OHIO
Fostoria Industrial Service
4500 Euclid Ave. . . . . Phone: Endicott 6622

COLUMBUS, OHIO
Electric Power Equipment Company
57 E. Chestnut St. . . . . Phone: Adams 5215

DALLAS, TEXAS
The Folsom Company
509 Elm St. . . . . Phone: Riverside 9803

DETROIT, MICH.
Fostoria Engineering Service
2615 12th St. . . . . Phone: Cadillac 0043-44

FINDLAY, OHIO
Fostoria Industrial Service
(Div. of Bearing & Transmission Co.)
211 N. Main St. . . . . Phone: Main 755

FT. WAYNE, IND.
National Mill Supply Company
207 E. Columbia St. . Phone: Anthony 2331

HARTFORD, CONN.
Electrical Supplies, Inc.
320 Ann St. . . . . Phone: 7-7111

INDIANAPOLIS, IND.
Fostoria Industrial Service
548 Massachusetts Ave. . . Phone: R. I. 2934

KANSAS CITY, MO.
Fostoria Industrial Service
324 Mfgrs. Exch. Bldg. . . . . Phone: Vic. 0770

LOS ANGELES, CALIF.
Fostoria Industrial Service
(Div. of Machinists' Tool & Supply Co.)
3690 Santa Fe Ave. . . . . Phone: Jef. 6294
Fostoria Industrial Service
(Div. of Quality Electric Company)
1235 E. Olympic Blvd. . . . Phone: Trin. 5981
Fostoria Industrial Service
(Div. of Leo J. Meyberg Co.)
2027 S. Figueroa St.

LOUISVILLE, KY.
Pickrell & Craig, Inc.
209 E. Main St. . . . . Phone: Jackson 5331

MILWAUKEE, WISC.
Fostoria Engineering Service
104 E. Mason St. . . . . Phone: Daly 2949

MINNEAPOLIS, MINN.
Fostoria Industrial Service
(Div. of W. M. Cotie & Associates)
2 Foshay Tower . . . . . Phone: Atlantic 7363

NEW ORLEANS, LA.
Electric Appliance Company
500 Camp St. . . . . Phone: Raymond 7151

NEW YORK, N. Y.
Fostoria Industrial Service of N. Y.
92 Warren Street . . . . . Phone: Worth 2-3352

NORFOLK, VA.
Fluorescent Light Company, Inc.
857-65 West 44th St. . . . . Phone: 38092

OAKLAND, CALIF.
Fostoria Industrial Service
(Div. of Pacific Electric Motor Company)
10th & Oak Sts. . . . . Phone: Glencourt 1844

OMAHA, NEBR.
Fostoria Industrial Service
1107 Farnum St.

PITTSBURGH, PA.
Fostoria Industrial Service
7133 Frankstown Ave. . . . . Phone: Fr. 0100

PHILADELPHIA, PA.
(see Bala-Cynwyd)

PORTLAND, OREGON
Fostoria Industrial Service
(Div. of Ken R. Humke Company)
207 N. W. 14th St. . . . . Phone: Atwater 7233

ROCKFORD, ILL.
Fostoria Industrial Service
510 Walnut St. . . . . Phone: Blackhawk 850

ST. LOUIS, MO.
Fostoria Industrial Service
1706 Olive St. . . . . Phone: Central 0153

SAN FRANCISCO, CALIF.
Fostoria Industrial Service
(Div. of Leo J. Meyberg Co.)
70 Tenth St. . . . . Phone: Underhill 1212

SEATTLE, WASH.
Fostoria Industrial Service
(Div. of David Y. Robinson)
1915 First Ave., S. . . . . Phone: Main 0919

SPOKANE, WASH.
Fostoria Industrial Service
(Div. of Hotchkiss & Gilkey Company)
1224 W. 1st Ave. . . . . Phone: Main 2411

TOLEDO, OHIO
Fostoria Industrial Service
(Div. of Bearing & Transmission Co.)
2144 Madison Ave. . . . Phone: Garfield 4302

TROY, N. Y.
General Electrical Service
203 River St. . . . . Phone: Troy 2759

For LARGE PLANTS

FLEUR-O-LIERS available . . . set by

Non-ferrous reflectors conserve critical material

Make this label your key to conversion lighting . . .
Over 45 manufacturers have earned the right to use it!

Fleur-O-Lier Manufacturers are making available designs which will meet the U. S. Bureau of Standard's specifications. Considerable work has already been done on substitute materials which promise to give satisfactory service. Some actually have a higher reflection factor than porcelain enameled steel. Potential alternates, less critical for war needs, include wood fiber, asbestos, specially treated paper, gypsum, plastics . . . all finished with a highly reflective white coating.

(Fleur-O-Lier installations in this advertisement were made before the new non-ferrous fixtures were available. Present stocks of steel reflectors will be available until exhausted)

FLEUR-O-LIERS furnish an even distribution of high intensity daylight for inspection and safety in handling sheet metal.

FLEUR-O-LIERS provide even, shadow-free light in this fabrics shop helping to prevent cutting mistakes which would mean accidents and waste.

OR SMALL

in new standardized design Bureau of Standards and WPB

These lines of diffused fluorescent light in FLEUR-O-LIERS mean better, faster, more accurate seeing for this airplane parts drafting room.

Precision and speed are uppermost in this airplane engine plant. These sturdy 100-watt FLEUR-O-LIER units are helping to keep production in high gear.

The new FLEUR-O-LIERS, with non-ferrous reflectors will be made available by over 45 leading fixture manufacturers located at important points all over the country. Of course these new fluorescent fixtures will still require the necessary WPB priority rating. • FLEUR-O-LIERS are *tested* and *certified* by impartial Electrical Testing Laboratories of New York as meeting 50 definite Standards set up by MAZDA lamp manufacturers for balanced performance and satisfactory operation.

When replacements of *starters* or *ballasts* are necessary, be sure they're ETL Certified...for your protection and your customers'.

Get this new booklet for full details and list of manufacturers. Write FLEUR-O-LIER MANUFACTURERS, 2122 Keith Building, Cleveland, O.

FLEUR-O-LIERS

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements

SPECIFY Guth FOR DEPENDABLE

Guth Fixtures are Engineered for Factory, Drafting Room and Office Needs!

WE GIVE you two of the most important essentials for today's Production demands. First, with our 40-years of lighting experience, we manufacture the efficient, high-quality Fluorescent Lighting Equipment necessary to provide good *illumination*. And second, our entire factory and force is geared up to give quick *delivery* on jobs of 1 to 1000 units.

Write or Wire TODAY for full details about GUTH Dependable FLUORESCENT!

For Factories

AT LEFT: *Guth installation in large Industrial Plant. For the Production, Assembly, or any other Plant Department, for 15, 25, 50 or 100 Foot-Candles, specify* "GUTH INDUSTRIAL FLUORESCENT." *Many types to choose from; all engineered to* LIGHT *the job* RIGHT!

INSET: *Plant-Office; one of thousands where* GUTH M1640 *units can be instantly installed. For the long hours in these "Plant Cubbys,"* LIGHT-UP WITH GUTH STRIPS!

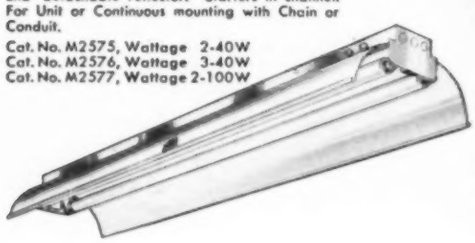
Write for Catalog No. 40 and Latest Literature

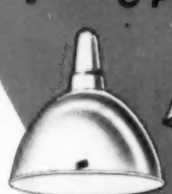
INDUSTRIAL LUMINAIRES

PORCELAIN ENAMEL — OPEN OR CLOSED-END TYPES

VICTORY XLO—Porcelain Enameled, Open-End detachable reflector. Starters in channel. For Unit or Continuous mounting with Chain or Conduit.

Cat. No. M2575, Wattage 2-40W
Cat. No. M2576, Wattage 3-40W
Cat. No. M2577, Wattage 2-100W





HIBAYS & LOWBAYS
For Filament and Mercury Lamps

Porcelain Enameled reflector units. Lamp shielding. Heavy-duty sockets.

LOWBAYS AAA260-264 — 75W to 500W
HIGHBAYS AAA [illegible] — 750W to 1500W

XLO FLUOFLECTOR — Closed-End, Porcelain Enameled reflector unit. Easy chain hanging. Starters in channel.

Cat. No. M2550, Wattage 2-40W
Cat. No. M2551, Wattage 3-40W
Cat. No. M2552, Wattage 2-100W

Quick Service on FLUORESCENT

For Offices and Drafting Rooms

Speed of Production starts in the Drafting Room, the Engineering Office and the Administrative Offices. Ease-of-Seeing for the critical tasks involved depends on quality and quantity of illumination. Specify GUTH, for these tough lighting jobs!

FUTURLITER—For 25 to 100 Foot-Candles, Eggcrate Shielded, Semi-Direct-type lighting. Continuous and Unit mounting. Cat. No. M2500 Wattage 2-40W Cat. No. M2501 Wattage 3-40W

FLU-O-INDIRECT—For 25 to 50 Foot-Candles of totally Indirect lighting. Highest quality illumination. Cat. No. M2320 Wattage 2-100W Cat. No. M2321 Wattage 2-40W Other Wattage Sizes available.

EXCELUX—For 15 to 50 Foot-Candles of Glass Shielded, Semi-Direct lighting. Suspended or ceiling mounted. Cat. No. M2100 Wattage 4-40W Cat. No. M2170 Wattage 6-40W

RECESSED TROFFERS—For 50 to 100 Foot-Candles. Deep and Shallow types. Baffle and Eggcrate Shielding, or Glass diffusing types. For all wattages.

TRUCOLITE—For 25 to 100 Foot-Candles of Open, Eggcrate Shielded or Glass Diffused lighting. Unit or Continuous mounting. Cat. No. M2455, Open 4-40W Cat. No. M2465, Eggcrate 4-40W Cat. No. M2475, Glass 4-40W

FORTIETH YEAR OF Guth LIGHTING LEADERSHIP

THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis, Mo.

SPERO offers you ...5 LINES of Products

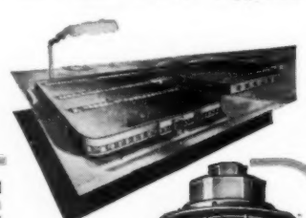
Floodlites—types for regular or special installations.

LET'S LOOK AT THE RECORD . . . TO SEE WHERE SPERO IS SERVING TODAY IN ONE OR MORE CAPACITIES

	Reflectors	Fluorescent	Floodlights	Vapor Proof Units	Electrical Construction Materials
Aircraft Plants	X	X	X		X
Ordnance Plants	X	X	X	X	X
Army Camps	X		X	X	X
Navy Yards	X		X	X	X
Industrial	X	X	X	X	X
Defense Housing	X				X
Ammunition Depots	X		X	X	X

FROM ONE DEPENDABLE SOURCE

● A most important factor in your participation in the Victory Program is your source of supply . . . for, you must have their cooperative effort that helps you to complete, on schedule, those many vital jobs you're handling. In this respect, consider SPERO . . . they offer you recognized quality and delivery, and 5 *LINES OF PRODUCTS* as well . . . each designed and built to meet standard needs in their respective fields. FLOODLITES, REFLECTORS, INDUSTRIAL FLUORESCENT LIGHTING, ELECTRICAL CONSTRUCTION MATERIALS and VAPOR PROOF UNITS . . . these are SPERO's five main product divisions . . . by choosing SPERO as your sole supplier, you eliminate the need to coordinate deliveries from several suppliers.



Our large plant is geared to produce in anticipation of your demands. Select SPERO as your source of supply on these five lines of electrical equipment.

Incandescent reflectors and fittings—all types and sizes.

Vapor Proof Units and Accessories—3 types, with or without reflectors, guards or fittings.

THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

HERE'S P OF PERFOR M

. . . . SOME NOTABLE PRO BY SPE

REFLECTORS

*Iowa Ordnance Plant
*Camp Carson
Camp Shelby
Camp Kelmer
*Wheeler Shipbuilding Co.
Arkansas Ordnance Plant

FLOODLIGHTS

*American Shipbuilding Co.
*Wheeler Shipbuilding Co.
U. S. Naval Air Station
Brooklyn Navy Yards
Federal Office Building
*Goodyear Aircraft Co.
Fort Monmouth

MATERIALS FOR ELEC

*Iowa Ordnance Plant
*Camp Carson
Camp Swift
Aluminum Corp. of America
Lawton Housing Corp. (Defense Housing)
Warner & Swasey Co.
Wright Aeronautical Corp.

* Denotes more than one li

S PROOF
OF
R MANCE

ABLE PROJECTS SUPPLIED
BY SPERO

● **FLUORESCENT**

Douglas Aircraft Co.
Timken Ordnance Co.
Cleveland Tractor Co.
*Goodyear Aircraft Co.
Chrysler Bomber Plant
*B. F. Goodrich Co.

● **VAPOR PROOF UNITS**

*Naval Ammunition Depot
Louisiana Shipyards, Inc.
*Iowa Ordnance Plant
Camp Lee
U.S.O. Building (4 projects)
Navy Yard Barracks
Middleton Air Depot

ELECTRICAL CONSTRUCTION

*Goodyear Aircraft Co.
*Goodrich Co.
Republic Steel Co.
Ford Bomber Plant
Consolidated Aircraft
*Naval Ammunition Depot
Firestone Tire & Rubber Co.
Allis-Chalmers Mfg. Co.

ense

one line purchased for the same job.

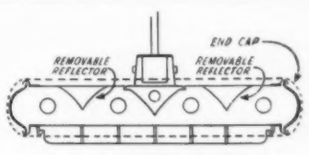
SPERO

features FLUORESCENT

that combines outstanding design features and striking appearance

. . . THE LVR448 FOR ENGINEERED EFFICIENCY IN OFFICE LIGHTING!

● Good lighting in the office is increasingly essential with the ever growing amount of exacting work involved in the administration of our Victory program. In this respect, SPERO features the LVR448 . . . a shielded fluorescent fixture that gives a sufficient amount of light of low surface brightness needed to do such a job. The SPERO LVR was designed especially for this purpose. It embodies all efficiency features, plus engineering for ease of maintenance, plus up to the minute styling.



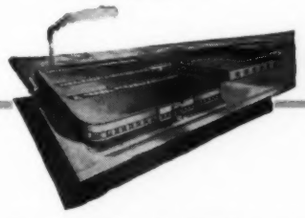
DEPTH 3⅜" WIDTH 15⅝" LENGTH 48"

EFFICIENCY FEATURES INCLUDE —Egg crate louvre for shielding the light. Removable auxiliary reflectors, all reflecting surfaces finished in "Plastox" white (88% reflection factor). Built for stem and close to ceiling mounting.

EASE OF MAINTENANCE—Louvre easily removed, auxiliary reflectors snap out for cleaning, relamping from the top without disturbing louvre, starters replaced from the top. Ballasts replaceable without taking the fixture from the ceiling.

MODERN APPEARANCE—The SPERO LVR448 with its evenly spaced louvres and glowing plastic side panels strikes a new note in streamlined styling. Smartly styled canopy and end pieces finished in pearl gray, complete the design and make this fixture a compliment to any office.

SPECIFICATIONS — All auxiliary equipment approved, power factor corrected, wired for 110-125 volt A.C. approved by Underwriters Laboratories. End plates snap on.



Our large plant is geared to produce in anticipation of your demands. Select SPERO as your source of supply on these five lines of electrical equipment.

THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

EXTEND

THE EFFECTIVENESS OF PROTECTIVE FLOODLIGHTING WITH

SANGAMO TIME-SWITCHES

FULL automatic control, as provided by Sangamo Time-Switches, extends the effectiveness of protective floodlighting. It adds to the protection of floodlighted factory yards, building approaches, railroad sidings, storage yards, and other vital property serving in war production, by eliminating the factor of human forgetfulness. A Sangamo Astronomic Dial Switch, especially, adds convenience, because the frequent resetting for the changing length of daylight is unnecessary. This switch does this automatically—every day—in exact accordance with suntime. A complete line, including astronomic dial, automatic carry-over, and outdoor time-switches, permits the selection of the exact form of Sangamo Time-Switch for any specific requirement.

DURING BLACKOUTS

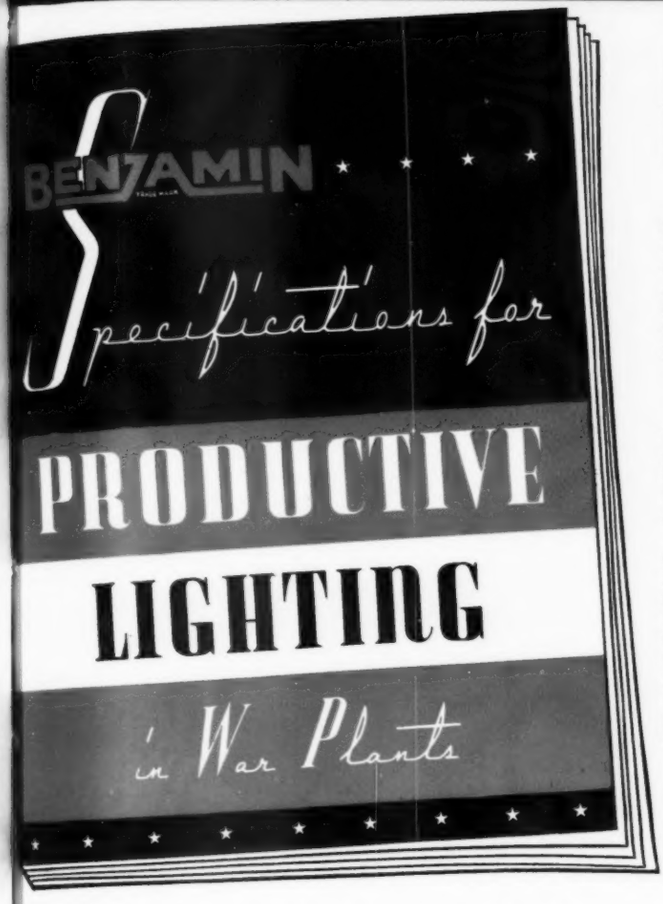
DURING any current interruption, as for instance when a master-switch is pulled for a temporary black-out, Form VSWZ Astronomic Dial Time-Switch will continue to run for ten hours. An automatic carry-over feature provides for clock-spring operation when the current is off. The clock-spring rewinds automatically when the current is restored, and the time-switch resumes its normal synchronous operation.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

NOW AVAILABLE

The New War Edition Lighting Guide That Shows You

HOW TO USE LIGHTING IN YOUR WAR PRODUCTION DRIVE



Send for This Free Guide to Make Certain You Are Not Overlooking Important Lighting Factors Essential to a Smoother Flow of Increased Output.

Many are the production problems in which lighting is an important factor. For basic to all sustained and efficient production is the worker's ability to see quickly, to see accurately, and to see easily. The worker can do none of these things without good lighting.

Practical Solutions to Production Problems

This new War Edition contains complete data on how to approach, analyze and solve lighting problems. . . . How to analyze the seeing task and determine the lighting requirements. . . . Quick Reference Tables for determining the amount and kind of light required for each of the six major classifications of seeing tasks . . . also valuable data on Lighting as it relates to the problems of increased production, employee fatigue, accident reduction, greater utilization of floor space, 24 hour operation, increased prevalence of employees with deficient vision and controlled conditions plants.

Actual Usable Solutions of 21 Lighting Problems

From the many specific lighting problems submitted for solution to the Benjamin Engineering Staff, there have been selected for publication in this new book, the twenty-one problems most frequently encountered by INDUSTRY CONVERTING TO WAR PRODUCTION. The practical solutions of these problems are illustrated by means of diagrams and layouts. It is the purpose of these problem solutions to provide you with practical solutions of similar problems and to serve as guide in planning new lighting installations and relighting projects.

Authoritative . . . Factual . . . Written in Non-technical Language

This guide has been prepared to meet the pressing need for a reference book by the busy executive, plant man, and architect and all others interested in the use of lighting as a production tool. In its preparation, full use has been made of the successful experiences of the many plants using Benjamin lighting equipment as well as data from reports and publications of the Illuminating Engineering Society, RLM Standards Institute, The National Safety Council and the new "American Recommended Practice of Industrial Lighting" approved by the American Standards Association.

This Manual Brings You Up-to-Date Data on Use of Lighting as a Production Tool!

Contains pages on how to approach the lighting problem, how to analyze the seeing task, how to analyze the factors involved in proper equipment selection . . . also how to determine the proper amount of footcandles with special up-to-minute footcandle recommendation tables as guides.

Here are a few of the twenty-one problem solutions given in this Manual

- How to Provide Efficient High Level Fluorescent Lighting for Large Areas.
- Fluorescent Lighting for Areas Requiring Moderately High Intensities.
- Glassteel Diffuser General Lighting of Soft, Well Diffused, Glareless Quality.
- General Overhead Lighting for High Bay Erecting Shops, Steel Mills, Foundries.
- High Level Local Lighting over Extended Areas of Inspection or Assembly Benches.
- Local Lighting of Spray Booths.
- Protecting Material in Open Vats from Contamination in Case of Broken Lamps.
- Safe Lighting in Atmospheres Containing Highly Flammable and Explosive Vapors.
- Lighting in Locations with Deteriorating Effects of Steam Vapors and Moisture.

BENJAMIN TRADE MARK

WORLD LEADER IN INDUSTRIAL LIGHTING EQUIPMENT

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Limited Edition! Mail this Coupon for your FREE Copy Today

BENJAMIN ELECTRIC MFG. CO., DEPT. H, DES PLAINES, ILLINOIS

Please rush to me a complimentary copy of your new Book "Specifications for Productive Lighting in War Plants."

Name.....

Company.....

Address.....

City..... State.....

FIGHTING INFERIOR LIGHTING

In design and production of Fluorescent Starters, Starter Sockets and Lamp Holders, Lloyd begins where others leave off. Not content with a GOOD product, Lloyd always seeks to make a BETTER one. Lloyd fluorescent accessories have met the severest tests in many laboratories and in actual use. The results have justified all our claims.

† Listed and Approved by Underwriters' Laboratories Inc.
† Listed and Approved by Canadian Engineering Standards Association
** Certified by Electrical Testing Laboratory—Spec. 6*
*† * Certified to Fleur-O-Lier Standards*

†Twist-Type Combination Lamp Holder and Starter Socket

Patented

Blk. Cat. 353
Wht. Cat. 353-W

†Narrow Channel Lamp Holder

Blk. Cat. 171
Wht. Cat. 171-W

Single screw mounting. for use with 1" dia., T-8 or 1½" dia. T-12 lamps. Vibration proof lock Insulating flaps for terminals.

†Narrow Channel Lamp Holder

Blk. Cat. 172
Wht. Cat. 172-W

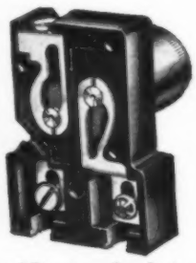
Bracket mounting. For use with 1" dia. T-8 lamps. Vibration proof lock. Insulating flaps for terminals.

†Push Type Combination Lamp Holder and Starter Socket

Patented

Blk. Cat. 253
Wht. Cat. 253-W

Holder and Socket Ratings: 660 Watts—250 Volts



†Starter Socket

Blk. only—Cat. 252

Showing "Lobster Claw" Dual Lock Contact.

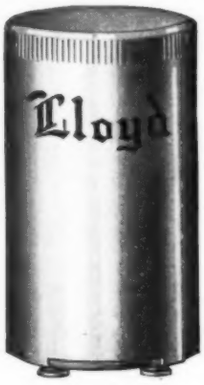
(Reg. U. S. Pat. Off.) Patented

Used in combination with 353, 353-W, 253 and 253-W

†"NO-BLINK" Starter

FS-4 NA

Prevents "dead lamp" sabotage. Stops blinking and flickering of defective or wornout lamps.



† FS-6

for 100-watt Lamps

† *FS-2 for 15 and 20-watt Lamps

† *FS-4 for 30 and 40-watt Lamps

Certified by E. T. L. Spec. 6

†Remote Starter Socket

Blk. Cat. 352

For separate mounting to make starter readily accessible. Has "Lobster Claw" Dual Lock Contact.

(Reg. U.S. Pat. Off.) Patented

LLOYD POLICY INSURES QUALITY

Lloyd PRODUCTS COMPANY

BOX C — EDGEWOOD STA., PROVIDENCE, R. I.

REPRESENTATIVES — BRANCH OFFICES — WAREHOUSE STOCKS IN 23 LEADING CITIES

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Dallas, Texas

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Denver, Colorado

S. L. BAGBY CO.
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Charlotte, N. C.

NATHAN H. BASS CO.
4685 N. Woodburn St.
Milwaukee, Wis.

DAVID BLEIMAN CO.
139 N. 4th St.
Philadelphia, Pa.

J. M. BOOTH SALES
312 Mills Street
El Paso, Texas

COASTAL SALES CO.
2130 N. E. Sandy Blvd.
Portland, Oregon

COASTAL SALES CO.
2515 LaSalle Ave.
Los Angeles, Cal.

COASTAL SALES CO.
2330 Market St.
San Francisco, Cal.

COASTAL SALES CO.
1001 Westlake Ave., North
Seattle, Washington

COREY CO., INC.
81 Murray St.
New York, N. Y.

JULES J. DREYFUSS & SONS
1404 N. W. 7th Ave.
Miami, Florida

EMDECA PRODUCTS CO.
509 McGill Street
Montreal, Canada

HAWKINS ELECTRIC SALES
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THE HEIMANN CO.
1218 Harmon Place
Minneapolis, Minn.

E. B. HENDERSON CO.
710 N. 12th Blvd.
St. Louis, Mo.

J. A. JAQUES CO.
620 W. Jackson Blvd.
Chicago, Illinois

W. D. JOHN CO.
133 Mass. Ave.
Detroit, Mass.

KILKENNY COMPANY
223 Rockefeller Bldg.
Cleveland, Ohio

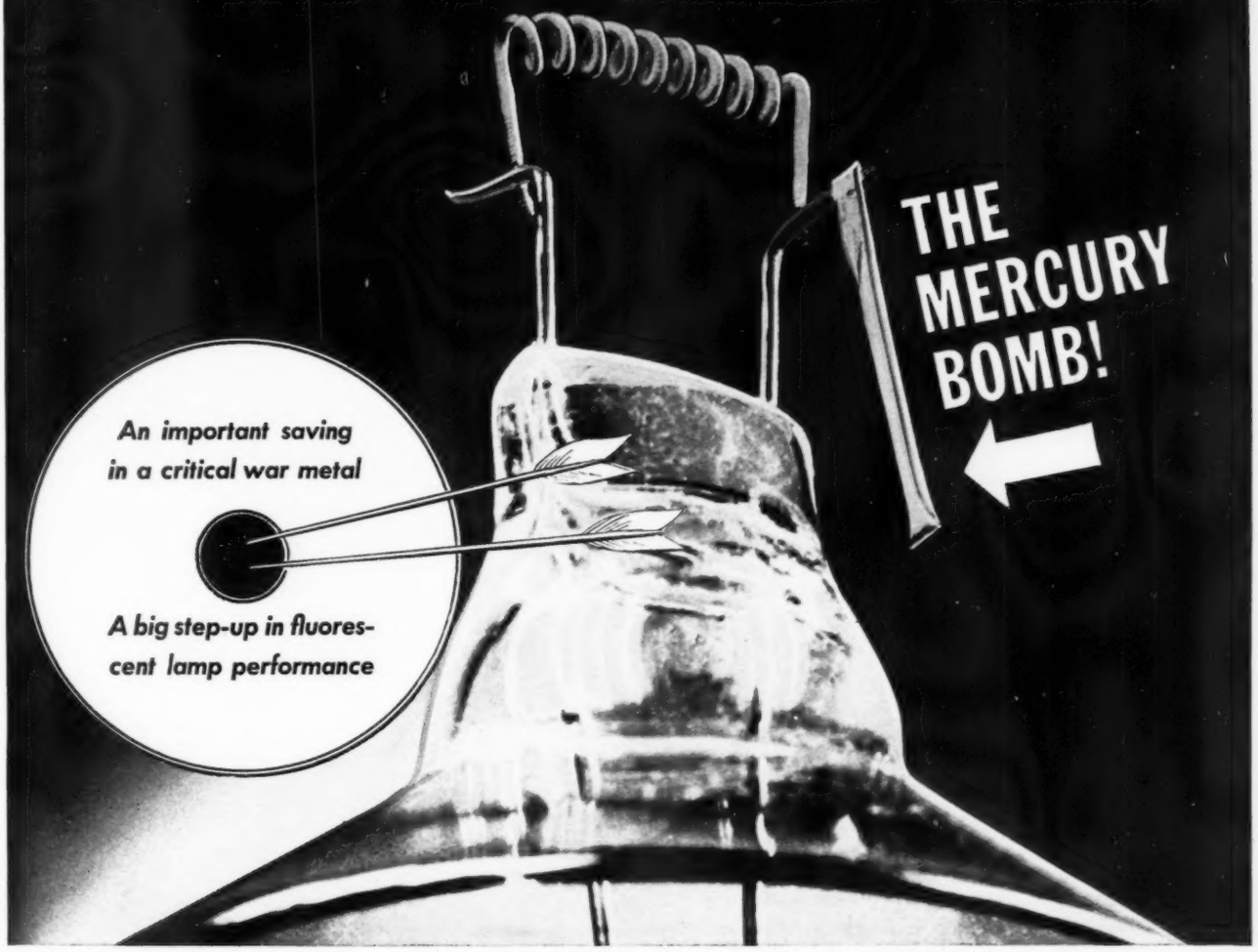
L. H. McMASTERS CO.
P. O. Box 700
Amargura 5-7-9-11
Habana, Cuba

Rocke International Elec. Corp.
100 Varick Street
New York City

J. A. SINES AGENCIES
1776 W. 24th St.
Los Angeles, Cal.

CHARLES D. WHITE CO.
589 Atlantic Ave.
Boston, Mass.

IT HITS THE TARGET TWICE!



ALL fluorescent lamps are alike in that each requires the use of mercury—an essential war material.

But lamps differ widely in the way that material is used.

Through the newly patented "mercury bomb,"* Hygrade Lamps now get twice the good out of the same volume of mercury—they stretch this scarce and vital metal 100% further.

But more than that—this remarkable new device lifts Hygrade performance to a new high level.

You see, too much mercury in a fluorescent lamp means more than waste—it means that the excess deposits itself on the surface in the form of dark streaks and splotches that cut down light output. On the other hand, too little mercury may cause the lamp to grow dim after a short period of service.

The "mercury bomb" rigidly controls—to the thousandth of a gram—the amount of mercury used in Hygrade Lamps; assures precisely the right quantity to keep them "bright to the last inch."

There are four other good reasons—easily verifiable—why Hygrade Sylvania Lamps can best serve wartime lighting needs. They give *more light;* they have a *smoother coating texture;* they're *uniform in color;* they *last longer.*

These fine lamps work well in any type of fixture. They're at their best when operating in fixtures made for them—"Miralumes"—complete Hygrade fluorescent units in which each part teams up with the rest.

If you haven't yet received our free file-size kit—containing catalogs, prices and complete technical specifications on all Hygrade Fluorescent Lighting Equipment—write today to Dept. EC-7, Hygrade Sylvania Corporation, Salem, Mass.

U. S. Patent No. 2,283,189

HYGRADE SYLVANIA CORPORATION

SALEM, MASS.

Makers of Hygrade Incandescent Lamps, Fluorescent Lamps, Fixtures, Starters, Sockets and Sylvania Radio Tubes

CHECK FLUORESCENT FIXTURES IN 60 SECONDS— with a DACO FLUORTEST!

WAR SCHEDULES MUST BE MET! Avoid faulty fluorescent installations and lighting delays by installing and maintaining fluorescent lighting with Daco Fluortest.

Not more than ***one minute*** is required to fully analyze the condition of an 110-120 volt, 220-240 volt, D. C. or A. C., any cycle, fluorescent fixture with Daco Fluortest. It registers condition of line voltage, lamp voltage, wiring accuracy, reactors, ballasts, compensators, lamps, starters, etc., whether wired in the fixture or out of the fixture.

Simple to operate, Daco Fluortest assures the correct installation, fast service and low maintenance cost of fluorescent lighting . . . vital elements in war production!

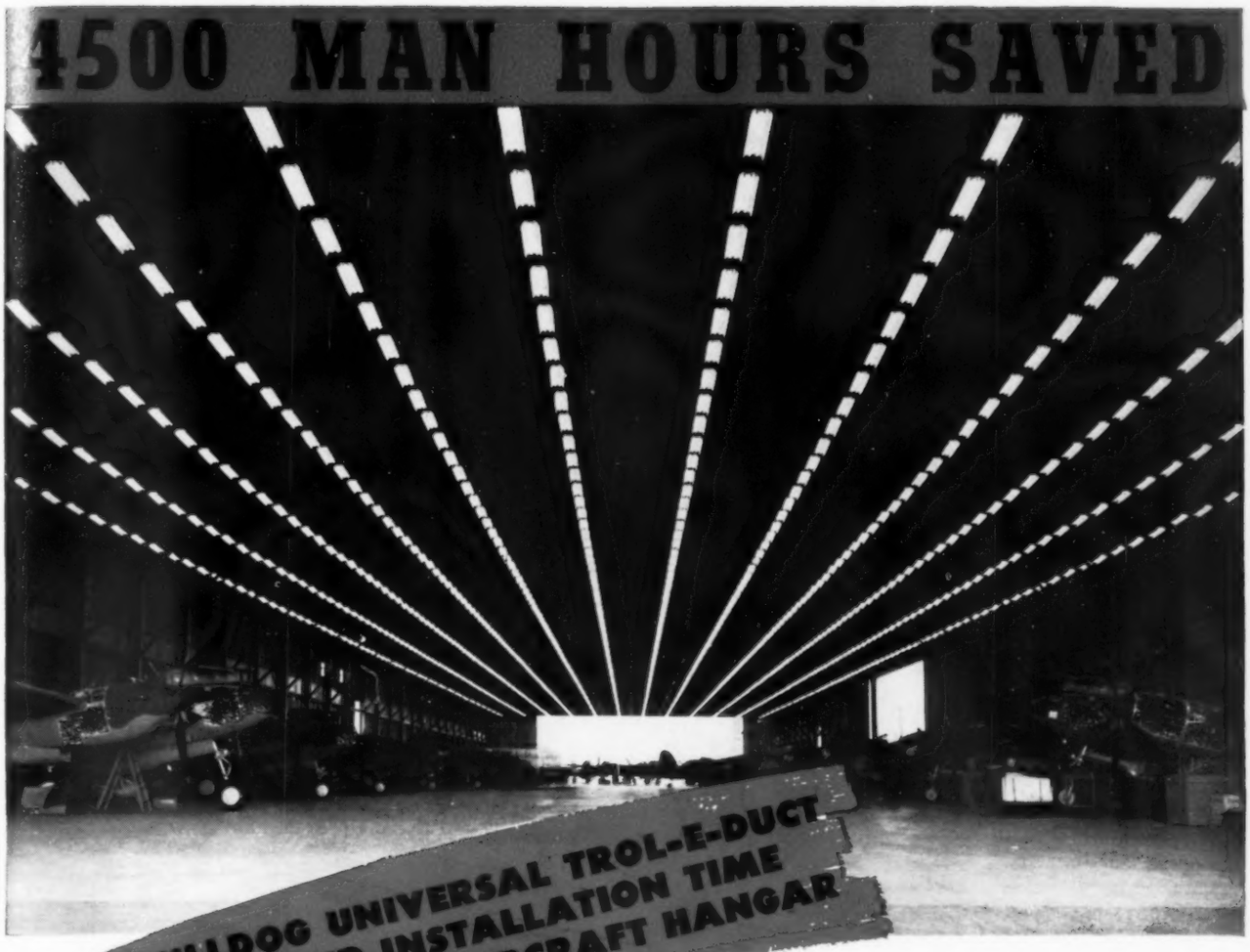
DACO *FLUORTEST JUNIOR,* for testing fixtures only, is available at $32.90.

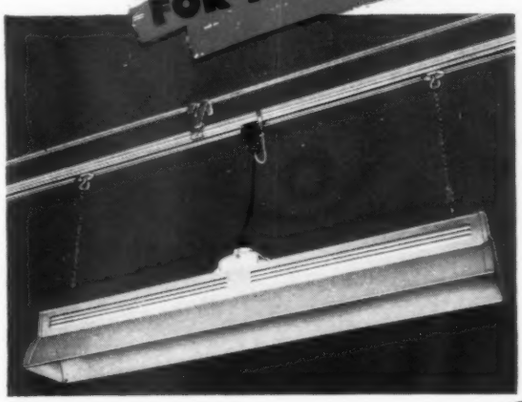
- Because of the heavy war demands on our production facilities, at the present time Daco Fluortest equipment can be supplied only to those with priorities.
- Daco Fluortest instruments are manufactured under exclusive patents by The Dayton Acme Company, famous as the manufacturers of DACO and DARAD precision electrical instruments.

THE DAYTON ACME CO., 930 YORK ST., CINCINNATI, OHIO

Member FLEUR-O-LIER Manufacturers

4500 MAN HOURS SAVED





A run of Universal Trol-E-Duct hung from messenger cable, and a typical industrial fluorescent fixture suspended from the Trol-E-Duct itself by weight supports. Current is supplied through the Receptacle Twist-out Plug in which a fusible attachment plug is inserted for individual protection of fixture.

BullDog's simple, flexible, pre-fabricated design made an important three-way saving . . . *of time, money and materials* . . . in this great new aircraft flight service hangar, the largest of its kind in the country.

For light distribution, the contract originally called for an old-fashioned wiring system . . . *but when BullDog advantages were pointed out* the specifications were changed, and Universal Trol-E-Duct was substituted. Twelve 800-foot runs were used, feeding and supporting 1152 mercury rectified fluorescent fixtures.

The result: Installation time was 4500 man hours less than the estimated labor for the out-moded system. And in addition, large quantities of critical auxiliary materials which would have been used in the old-type system were saved.

Needless to say, buyer and contractor are now sold to the hilt on Universal Trol-E-Duct. Today this aircraft manufacturer has over twelve miles of Trol-E-Duct installed throughout various plants.

BULLDOG
ELECTRIC PRODUCTS CO.
DETROIT, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ontario
Branch Offices in Principal Cities

Use Your Local BullDog Field Engineer

If you would like the many advantages of BullDog Universal Trol-E-Duct *for completely flexible "plug-in" lighting,* you should take advantage of the services of the nearest BullDog Field Engineer.

These men, conveniently located in all principal cities, are thoroughly competent to co-operate with architect, contractor or engineer in drawing up and submitting complete detailed layouts and specifications.

MANUFACTURERS OF Vacu-Break Safety Switches, SafToFuse Panelboards, Circuit Master Breakers, Switchboards, Bus Duct Systems—FOR LIGHT AND POWER

On Industrial Fluorescent Units

CERTIFIED BY RLM

This simple buying step is your best assurance that the Industrial Lighting Units you install will provide the maximum value in lighing efficiency and economy . . . will deliver the balanced lighting so essential to maximum output of National Defense Products . . . will protect the welfare and promote the efficiency of employees called upon to work longer hours and at higher speeds.

Specifications for Certified RLM Industrial Lighting Units have been established by extensive research and scientific tests. Conformity to RLM Specifications is assured by a rigid and continuous inspection and testing system conducted by Electrical Testing Laboratories.

Thus, the RLM LABEL becomes the user's warranty that the fixtures, auxiliary control equipment, sockets and other component parts of the Lighting Unit bearing it are properly engineered for co-ordinated operation with Mazda Lamps to give maximum light output and trouble-free operation. Write for copies of RLM Specifications.

Industrial Lighting Produced By The Following Manufacturers Have Been Tested and Approved by Electrical Testing Laboratories as Meeting RLM Specifications:

ABOLITE REFLECTOR COMPANY
West Lafayette, Ohio

BENJAMIN ELECTRIC MFG. CO.
Des Plaines, Ill.

BRIGHT LIGHT REFLECTOR CO.
Brooklyn, N. Y.

DAY-BRITE LIGHTING, INC.
St. Louis, Mo.

GOODRICH ELECTRIC COMPANY
Chicago, Ill.

THE MILLER COMPANY
Meriden, Connecticut

OVERBAGH AND AYRES MFG. CO.
Chicago, Ill.

QUADRANGLE MFG. COMPANY
Chicago, Ill.

SMOOT HOLMAN COMPANY
Inglewood, California

WESTINGHOUSE ELECTRIC AND MFG. COMPANY
Cleveland, Ohio

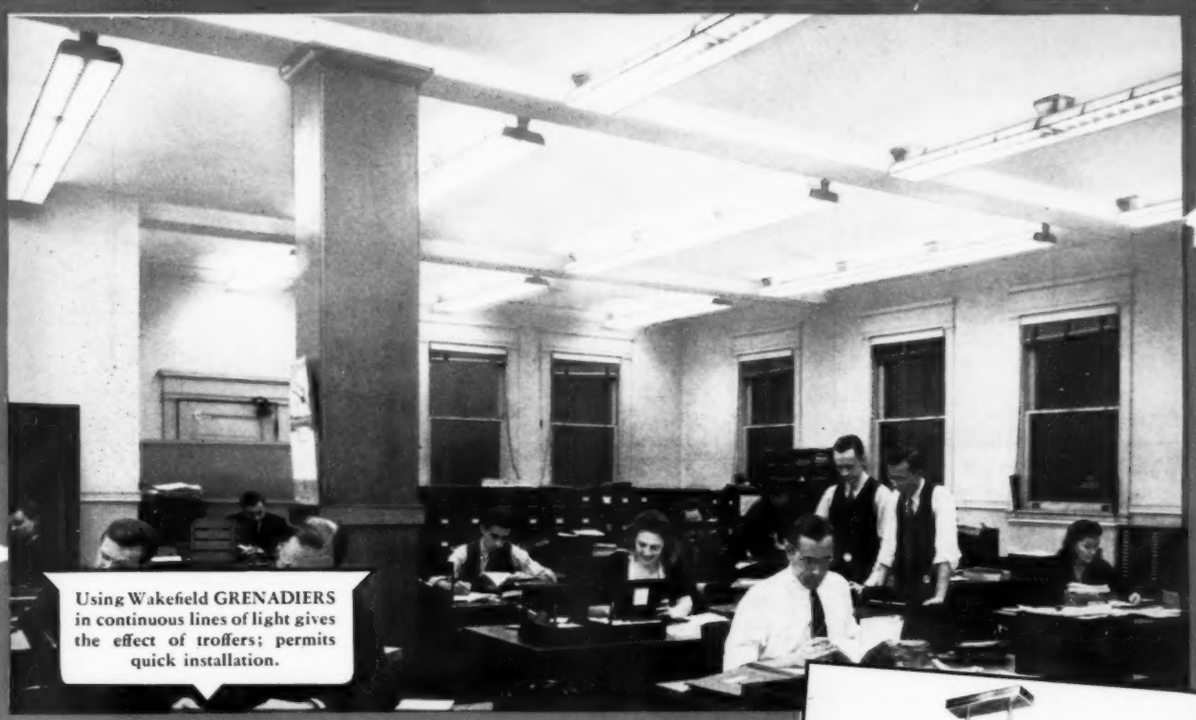
WHEELER REFLECTOR CO.
Boston, Massachusetts

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

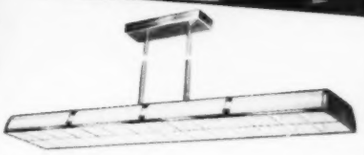
RLM STANDARDS INSTITUTE
INCORPORATED

307 N. MICHIGAN AVE. • SUITE 1600 • CHICAGO, ILL.

VICTORY calls for "seeing" insurance in plant offices, too!



Using Wakefield GRENADIERS in continuous lines of light gives the effect of troffers; permits quick installation.



The GRENADIER . . . Efficient 2-lamp unit. Provides smooth, diffused overall light. Plastic insets on sides greatly reduce use of critical materials and weight. Units may be mounted end-to-end as suspended troffers. Reflecting surfaces face downwards, catch less dust; relamping is easy.

The ACE . . . Tops for high intensity downlight or where rooms have poor ceilings. Puts 90% of its light down on desk-top or board. A small amount of light upward prevents eye-straining contrasts. Adequate louvers assure smooth, diffused light. Narrow 3-inch depth adds to its trim appearance. Easy maintenance and relamping.

And they're both Certified FLEUR-O-LIERS!

See how Wakefield GRENADIERS help this Office *team with "the Shop"*

When Wakefield GRENADIERS relighted this purchasing and sub-contracting office, right away folks had MORE light . . . began to feel better.

More important, they had helpful insurance of seeing conditions for faster, more accurate work, with less eyestrain and fatigue. This helped speed typing, filing and all the "paper" work jobs so important today in helping to prevent "materials" bottlenecks for the production line. It also helped people keep at peak efficiency *longer*.

When you tackle war plant lighting problems, remember the office

"Seeing" insurance like this provides important help for any war plant office . . . helps office workers team up with the boys in the shop . . . for the all-out results that it takes to win. The F. W. Wakefield Brass Co., Vermilion, Ohio.

THE F.W. **WAKEFIELD** BRASS CO.

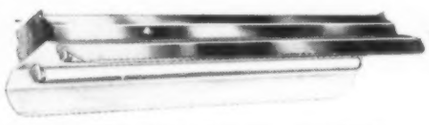
72 CONTRACT PARK · VERMILION, OHIO

"Skilled" Lighting

TYPICAL WHEELER FIXTURES

RLM Duratach Units

Made in Dome, Angle and all other standard types. Wheeler Duratach construction provides for quick and easy interchangeability of reflectors.



RLM Open-End Fluorescent Units

Made in two- or three-lamp constructions, units can be mounted from chain, conduit, or directly to ceiling. For use with 48-inch, 40-watt lamps. RLM units for use with 100-watt lamps also available.

Wheeler Vapor-Tight Fixtures

Made in all standard pendant and ceiling types. Designed to resist deteriorating effects of vaporous and atmospheric conditions.

Class II-G Dust-Tight Units

Approved for "Class II-G" hazardous locations. Hinged glass cover protects lamps, sockets and reflecting surfaces. Available for use with two or three 48-inch, 40-watt Fluorescent lamps.

Engineered by Wheeler to win prompt approval on PD-1A Applications

When you specify Wheeler Fixtures in your PD-1A questionnaire for conversion lighting, you remove one possible stumbling block to speedy approval by WPB authorities. For, Wheeler's complete line of Incandescent and Fluorescent Lighting Fixtures is *pre-approved* by either RLM or Underwriters' Laboratories!

Developed by Specialists

Wheeler Lighting Equipment is designed by specialists with over sixty years of lighting experience. It's *"skilled" lighting* that applies standard lamps with maximum efficiency. Every unit meets top standards of design, material and workmanship.

Complete Selection

All your requirements can be supplied by Wheeler's complete line. Wheeler engineers will give you the benefit of their experience by helping you plan the right installation.

Write for complete catalogs of Wheeler Incandescent and Fluorescent Fixtures. **Wheeler Reflector Company, 275 Congress Street, Boston, Mass.** . . New York . . Cleveland. Representatives in principal cities.

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Wheeler
REFLECTOR COMPANY
LIGHTING EQUIPMENT SPECIALISTS SINCE 1881

Count on MILLER Lighting and Engineering!

●

MILLER Continuous Wireway Fluorescent Lighting System

SAVES . . . POWER—Delivers maximum light output per kilowatt. • MANHOURS—Continuous wireway contains all operating auxiliaries, permitting rapid row-by-row installation. • CRITICAL METAL—As much as 47%, taking all items into consideration, power plant, distribution, controls, etc. • DOLLARS—Continuous wireway's features simplify installation, save from 30 to 50% of installation costs.

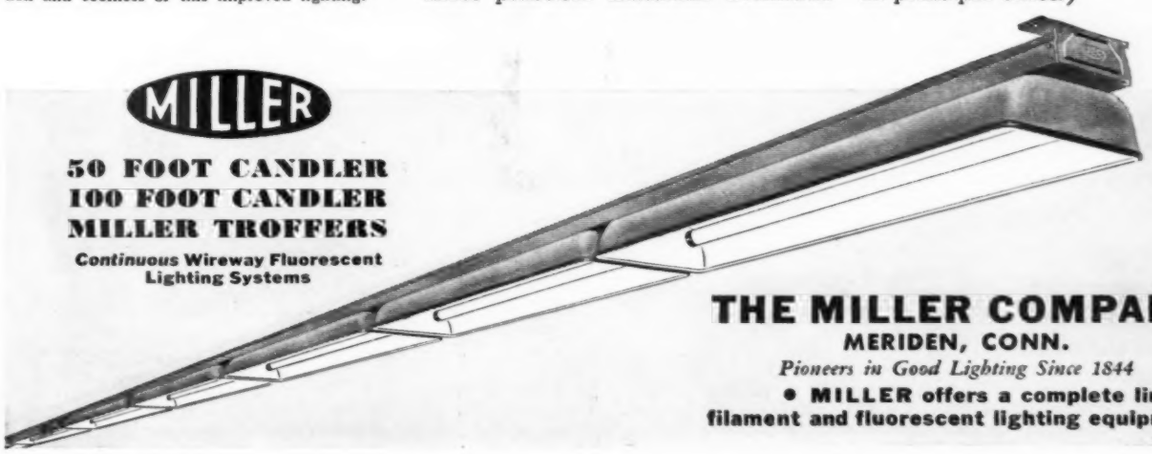
INCREASES . . . ILLUMINATION – Provides 50 foot candles, 100 or higher of working daylight for factory areas, plant offices and drafting rooms. • PRODUCTION—Field facts demonstrate plants using MILLER lighting have increased production efficiency. Figures on request. • FLEXIBILITY—Production layouts can be changed at any time without changing lighting. • WORKER MORALE—Employees feel better and work better with the greater illumination and coolness of this improved lighting.

THERE'S still some confusion on this question of war plant lighting, and we'd like to help clear it up.

For instance, there's talk about substitute materials for reflectors and other parts of fluorescent lighting equipment. Well, frankly, no one knows exactly when they will have to be used. *But of this you can be sure* —MILLER engineers, with 98 years of lighting specialization to their backs, will give you the most efficiently designed *complete* fluorescent lighting system, soundly constructed of the most practical materials available.

Today, like yourself, we have two masters to satisfy, Uncle Sam and war industry. We're not going to let either of them down.

If your customers are busy on war work, it's ten to one they're eligible for MILLER 50 FOOT CANDLERS or 100 FOOT CANDLERS for their production areas . . . MILLER TROFFERS for their plant offices and drafting rooms. No matter what today's conditions are, count on us to help you provide them with better working daylight to speed their war effort. *Wire today for complete information.* (Representatives in principal cities.)



MILLER

50 FOOT CANDLER
100 FOOT CANDLER
MILLER TROFFERS

***Continuous* Wireway Fluorescent Lighting Systems**

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844

• MILLER offers a complete line of filament and fluorescent lighting equipment

IS *Half* A BLINDFOLD SLOWING YOUR PRODUCTION?

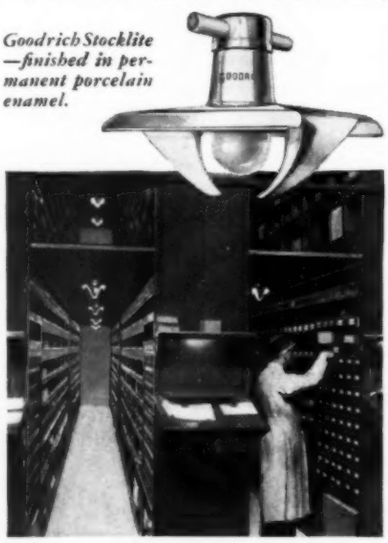
ALL stockrooms have *some* kind of lighting, but the efficient ones have *correctly designed* illumination to speed up the handling of war orders . . . to prevent costly mistakes . . . to avoid delays.

Created expressly for this purpose, the Goodrich Stocklite provides the exact pattern of light you need in stockroom aisles. It illuminates shelves uniformly from top to bottom row—delivers maximum intensities in bin interiors. Yet, there is complete absence of glare in the aisles because all the light is directed where it's needed, without waste. When stock clerks can see better, they work faster, more efficiently!

Typical of many outstanding Goodrich developments in industrial lighting, the Stocklite is used in hundreds of war plants and Government Departments. Ask for Bulletin No. 91.

Protecting vital plants with floodlighting—saving man-hours in production—Goodrich Industrial Fixtures are serving America's war effort everywhere.

Goodrich Stocklite—finished in permanent porcelain enamel.



SOLD ONLY THROUGH ELECTRICAL WHOLESALERS

GOODRICH
ELECTRIC COMPANY
OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 4602 BELLE PLAINE AVENUE, CHICAGO, ILL.

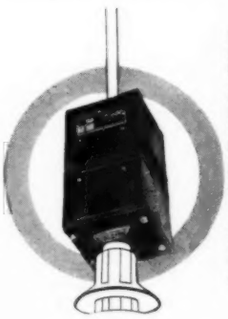
WAR PRODUCTION LIGHTING

NO BLACKOUT ALLOWED

Specify Acme Fluorescent Ballasts

Cheaply constructed, inefficient fluorescent fixtures have no place in War Production plants. For example; a ballast with unbalanced secondary voltage may cause flickering on one tube, or even fail to light the tube during long periods of time. And a burned-out ballast may waste hours of replacement time, meanwhile stopping production on vital war work. Acme *performance tested* ballasts are engineered and built to exactly meet lamp characteristics and provide for maximum light output, efficiency and trouble-free performance. Specify Acme Ballasts on War Production Fluorescent Lighting.

FOR HIGH BAY BUILDINGS
ACME HI-INTENSITY
MERCURY VAPOR TRANSFORMERS



Insist on Acme performance and specify Acme Hi-Intensity M.V. transformers for high bay lighting work. Transformer performance is vitally important to dependable service. Don't experiment, install Acme Hi-Intensity M.V. Transformers first. Write for Bulletin 149.

LIGHTING VOLTAGE FROM THE POWER LINE

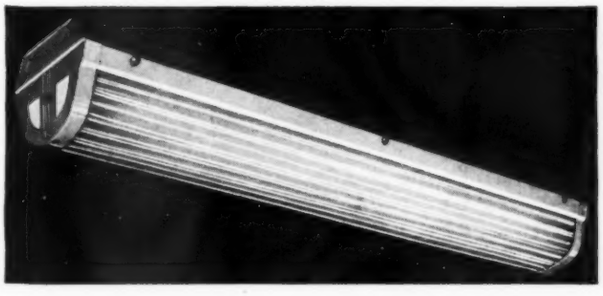
No more double-wiring systems with attendant waste. Now, save materials by installing Acme air-cooled transformers and tap off the power line where lighting or reduced voltage circuits are needed. Acme air-cooled transformers available in sizes from 1/10 KVA to 50 KVA, single and three phase, all standard primary voltages up to 2300/4160. Get Bulletin 147.

THE ACME ELECTRIC & MFG. CO.
36 Water St. Cuba, N. Y.

Acme ACME Electric
TRANSFORMERS

QUICK LIGHT CONVERSION SPEEDS WAR PRODUCTION

GLASS DRAFTING ROOM LUMINAIRE



The "Safirelite" one to four lamp units. Attractively styled and highly efficient. For surface or pendant mounting—Units are supplied with knockouts in each end, permitting continuous strip installations of either type.

CONSTRUCTION

Fixture body—all steel, with metal frame and metal ends with openings for luminous appearance, backed with plastic. High transmission; fluted glass is used in the metal frame which has a continuous piano hinge, letting the entire under-section swing down.

FINISH

Luminaire is finished in "Klasium" White. Reflector "Klasium" White— reflection 80 to 82%.

FIGHT WITH LIGHT

Put your plant on the offensive—Get those 24 hours of daylight so vital to the country's need today. Fluorescent lighting properly engineered will increase seeing for better and quicker work—will reduce accidents and insure greater sustained plant production.

Improved quantity and quality of lighting, conserves energy and wasted time . . . It is important that workers in the plant are provided with plenty of light.

Lighting Products lighting equipment is built for strength and durability and will stand up under the most severe service requirements found in industrial plants today. When properly specified and installed you will be assured of years of service

LIGHTING PRODUCTS ENGINEERING SERVICE

War production or essential civilian plants are invited to use the services of our Engineering Department for the preparation of lighting layouts or recommendations, without cost or obligation for any project either small or large. Lighting Products maintains lighting engineers in principal cities who will assist you.

Write today for detailed information about Lighting Products—efficient—easy to install fluorescent Luminaires.

LIGHTING PRODUCTS, INCORPORATED

HIGHLAND PARK ILLINOIS, U. S. A.

DONGAN

The Complete Line.

Fluorescent Lighting is a MUST in our WAR Program. Not alone will it give added light for better sight . . . it gives *better* light. It improves production . . . cuts down accidents. It will relieve over-loaded circuits . . . permitting increased POWER LOADS to be served from present electrical capacity.

Our Engineering Department has prepared interesting booklets on "Power Factor" and "Manual for Servicing Fluorescent Installations". Copies of both are available for the asking and will prove of interest to plant engineers, electricians and all interested in better fluorescent lighting.

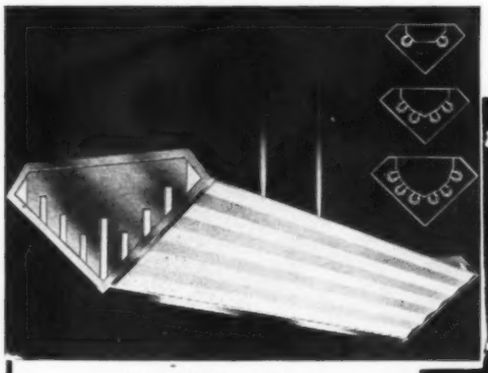
• • •

For your transformer requirements contact DONGAN . . . manufacturers of a complete line of Dry Type Transformers, including Ballasts, Mercury Vapor Lighting Transformers, Power Circuit Transformers for lamps, motors, controls and similar devices where lower voltages are required, Ignition Transformers, Neon Transformers and Transformers for Special Applications.

DONGAN ELECTRIC MANUFACTURING COMPANY

2985-2995 Franklin St. **Detroit, Mich.**

"THE DONGAN LINE SINCE 1909"



No. 448VS—4-40w
Pendant Fixture

A Known Product
takes on a new name
~~Claude Banks~~
now **KIRLIN**
LIGHTING

★ Kirlin presents a full line of fluorescent lighting, 96 designs for commercial and industrial installations. Illustrated is #448VS, List price $78.00, with usual fixture discounts. This unit is being used on many large War Plant projects, and delivery is good at present. There is no better quality in lighting than KIRLIN—write for catalogs or job recommendations. Also recessed flush units of all kinds—easily installed on job.

THE KIRLIN COMPANY
Former name — Claude Banks Company
3435 EAST JEFFERSON AVE., DETROIT, MICH.

SAVE TIME
(and how!)

WITH **Paragon CONTROLS**

Yes . . . you can save an amazing amount of precious time . . . in any one of a thousand manufacturing operations . . . by using Paragon Automatic Time Controls. You can increase output per man and speed up production.

900 SERIES

Paragon Controls are saving much time in plastic molding, rubber curing, heat treating, enamel baking, liquid agitation, light exposure, conveyor operation, power disconnect, machinery operation, etc.

Every Paragon unit is precision-built, simple, accurate, rugged, reliable and reasonably priced.

Write for this Book

A complete catalog describing industrial timers, time switches and other time control devices. Valuable for reference. Sent without obligation.

PARAGON ELECTRIC CO.
401 S. Dearborn St., Chicago, Ill.

Paragon
BUILDERS OF CONTROL INSTRUMENTS SINCE 1905
Chicago

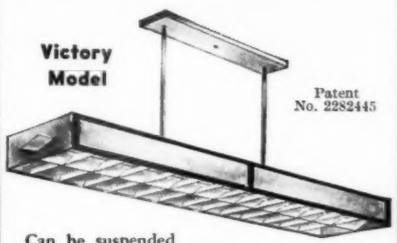
INCREASED PRODUCTION and EFFICIENCY with WILEY FLUORESCENT FIXTURES

There is a WILEY INDUSTRIAL

to fit your particular lighting need. Wiley Industrials may be installed as individual units or in continuous rows. Each unit is complete in itself and no "connecting boxes, ends", etc. are necessary. Optional louvers, glass bottoms or open end reflectors and "wide spread" or shallow reflectors are available.

Continuous, close to ceiling installation

Wiley Industrial Fluorescent Fixtures are the product of a pioneer manufacturer with the experience of many successful industrial installations.



Can be suspended with any length stems from center canopy end hangers or mounted flush to ceiling.

Recent WILEY Industrial Installations

WHITE MOTORS
BUFFALO FORGE CO.
PICATINNY ARSENAL
NORFOLK NAVY YARD DISPENSARY

Write for Booklet EC-72

R. & W. WILEY, INC.

777 Hertel Ave. Buffalo, N. Y.

Member Fleur-o-Lier Manufacturers Association

FOR WAR PLANT *Production AND Protection*

PERMAFLECTOR

Enclosed

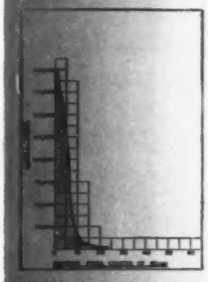
FLOODLIGHTS

Minimum of Critical Materials Used

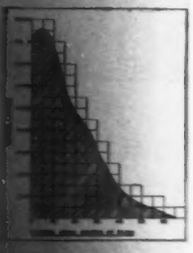
★ Designed and built expressly for our vital war of production, these Permaflector floodlights project a flood of high intensity light which effectively serves to defeat the saboteur or to accelerate the output of war material. These new enclosed Permaflector steel floodlights are complete, ready-to-install and consist of a formed steel case equipped with hinge and clamps, heat-resisting cover glass, cast iron base, wire cord grip fitting, three-foot length of duplex wire, mogul socket and a 1,000-watt size Permaflector, the silver mirrored glass reflector which provides engineered light control from extreme concentration to extra broad spread. Preadjustment at the factory permits the use of 300, 500 or 750-watt lamps with the 1,000-watt size unit. Completely weather-proof and corrosion-resistant, these floodlights are ideal for all outdoor floodlighting applications. They may be mounted on a vertical or horizontal surface or attached to a pipe and adjusted to almost any position.

Other War Uses

Airfields
Army Posts
Arsenals
Bridges
Construction Jobs
Dams
Docks
Mines
Pipe Lines
Power Stations
Railroad Yards
Substations
Viaducts



Concentrated Distribution Floodlights Numbers ST-1150-C, ST-1110-C. Addition of Stippled Cover Glass Provides Narrow Distribution.



Broad Distribution of Floodlights Numbers ST-1050, ST-1010.

PITTSBURGH REFLECTOR CO.
403 OLIVER BLDG., PITTSBURGH, PA.

PITTSBURGH REFLECTOR CO. EC-7-42
403 Oliver Building
Pittsburgh, Pa.
Please rush complete data on Permaflector Enclosed Floodlights.
Name.....
Firm.....
Address.....

MULTI REFLECTORS ... EASY TO WRITE SPECIFICATIONS For This Lighting EQUIPMENT • • •

because

MULTI FITS ALL RIGID REQUIREMENTS

● MULTI Fluorescents are designed for 20, 30, 40, and 60 watt lamps—open or closed ends—medium, wide, and concentrating spread—reflectors of porcelain enameled, and baked durenamel—chain or stem suspension—high or lower power factor. The Incandescents come in hundreds of types and sizes for modern efficient lighting in offices, shops, factories, etc. You can fill today's urgent industrial lighting needs with a MULTI—fluorescent or incandescent. Send for complete catalog.

Fluorescent and Incandescent

IDEALITE

FLUORAINE

FLUROLITE

INDUSTRIAL REFLECTOR

MULTI ELECTRICAL MANUFACTURING CO.
1840 W. 14th ST., CHICAGO, ILL.

REFLECTORS OF PROVEN DESIGN

The OAMCO line includes every size, style and type of reflector for industrial and commercial use. Whatever your requirements are, you will find OAMCO reflectors engineered to do the job perfectly—designed for maximum lighting efficiency—manufactured for long years of service. OAMCO reflectors are approved by the Electrical Testing Laboratories and are in accordance with the specifications of the RLM Standards Institute. Send today for our catalog showing the complete OAMCO line.

RIGHT LIGHT SINCE 1902

OVERBAGH & AYRES MFG. CO.

MEMBER OF THE R L M STANDARDS INSTITUTE

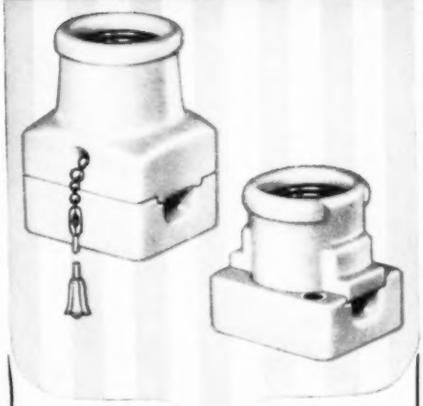
411 SOUTH CLINTON STREET • CHICAGO

P&S

WIRING DEVICES

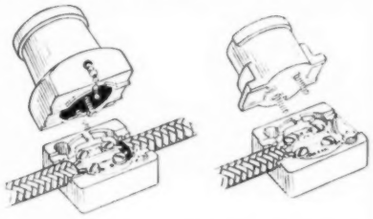
CONSERVE CRITICAL MATERIALS

★ ★ ★ ★ ★



No. 1701 No. 1700

Designed for today's market—New two-piece porcelain cablettes — for use with non-metallic sheathed cable. Install directly on surface—no boxes, clamps, connectors or soldering. Easy to wire and assemble.



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A new, highly efficient fluorescent unit . . . is Virden's contribution to the nation's war effort.

A NEW IDEA . . . the ballast is EXPOSED . . . uncovered to assure low temperature operation . . . a feature that makes for operating efficiency and also decreases weight and bulkiness in the fixture.

MAINTENANCE is cut to a minimum . . . the reflector is easily removable for cleaning without disturbing or turning off lamps. Starter switches also can be removed without touching lamps. This means continuous lighting for no loss of production.

EFFICIENCY . . . better than 80% output, with the light distribution broad for good vertical, as well as horizontal illumination.

These characteristics, coupled with many other features, make the VIRDEN fluorescent unit ideal for all out production lighting . . . can be ganged end-to-end, or used singly . . . write for folder VFK-42, it provides detailed specifications, photographs, and a general illumination guide for estimating foot candles.

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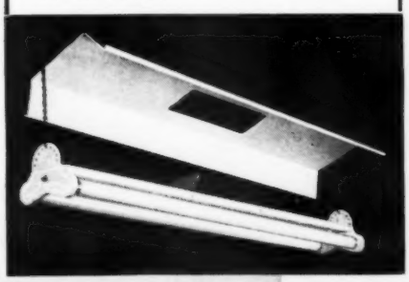
VIRDEN VALUE

Check This Feature ✓

Reflector is built to be removed easily —merely lift off. It's entirely separate from the fixture. There's no need to shut off lighting system to remove reflector for cleaning. *That means light all the time*—no production halts, no lost output.



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CONTRACTORS LIKE THEM BECAUSE:
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Revere announces AN OUTSTANDING LINE OF NEW FLOODLIGHTS

180° Fresnel Lens—Wide Angle Floodlight—originated by REVERE for Protective Lighting. Available in 4 styles.

Fresnel Floodlight—a very desirable unit for airplane hangar use, bridges, approaches, docks, yards, etc.

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DOME REFLECTOR
Dust-Tight, Cool-Operating, Dust Shedding—used in arsenals, loading plants, etc. Something new in principle. Underwriters listed for—Class 2, Group G Locations.

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Easy to Wire—Easy to Install Easy to Maintain

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INDOOR and OUTDOOR LIGHTING EQUIPMENT of EVERY DESCRIPTION

Fixture Hanger and Reflector PYLETS

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lighting fixture Pylets for ROC reflectors. Also with mounting flange, ROF Series. Can be furnished with hooks for messenger wire suspension.

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threaded flexible fixture hanger Pylets, allows fixture to swing. Also cushion style which absorbs vibration.

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for messenger wire suspension of pendant fixtures. Also suspension hangers and conduit clamps.

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fixtures—all types for surface, outlet box, handrail, wall mounting; single, two and three gang, for lamps 10 to 200 watts.

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How to design, install, and service fluorescent-lighting systems

MAKE SURE

you get the extra profits promised by the growing popularity of fluorescent lighting. Here is a practical manual covering the subject in all its aspects, presented so that anyone can understand it, with or without much electrical training. Gives the most authoritative information available on construction and performance of all types of fluorescent lamps, principles and methods of calculating illuminating requirements and designing luminaires and installations, pointers and methods of installing and maintaining fluorescent lamps and of locating and remedying their troubles. Includes working data, comparison of cost factors of fluorescent and incandescent lighting, etc.—everything to aid in the designing, selling, installing, and servicing of efficient and satisfactory, fluorescent-lighting systems.

Just Out!

FLUORESCENT LIGHTING MANUAL

By CHARLES L. AMICK
Nela Park Engineering Dept.,
General Electric Company

312 pages, 6x9, 217 illustrations, many tables. $3.00

CHAPTERS

1. The Fluorescent Lamp
2. Auxiliary Equipment
3. Operating Characteristics
4. Installation Hints
5. Service Suggestions
6. Luminaire Selection
7. Fluorescent-lighting Design
8. Color Quality
9. Fluorescent Applications
10. Lighting Economics

Besides giving a how-to-do-it cast to all information presented, the author emphasizes its meaning from the standpoint of answering doubts or questions regarding the value of using fluorescent lighting. From this book both newcomers in the lighting industry and more experienced readers will get an overall picture of every link in the fluorescent lighting chain and an appreciation of the importance of each, as well as instructions in the methods of design, installation, and servicing.

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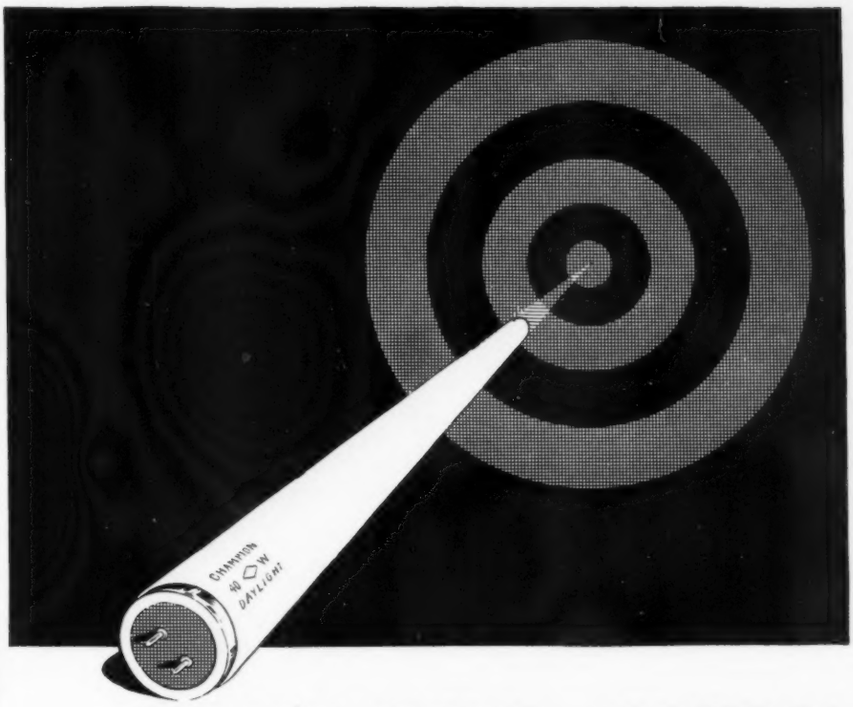

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Five, ten, twenty times the light intensities formerly employed are helping American industry to meet the greatest production schedule the world has ever witnessed.

If you haven't yet taken advantage of the tremendous lift in productivity and morale that is inherent in higher intensities thru the application of cool, glare-free Fluorescent light, don't put it off any longer. Champion engineers consider it a patriotic duty to assist you in every possible way.

CHAMPION *Fluorescent Lamps*

are in every respect worthy of the name "Champion" that has stood for quality, dependability and economy in electric lamps since 1900.

A Champion Lamp distributor specially selected for his ability to provide you with prompt and intelligent service is at the other end of your phone.

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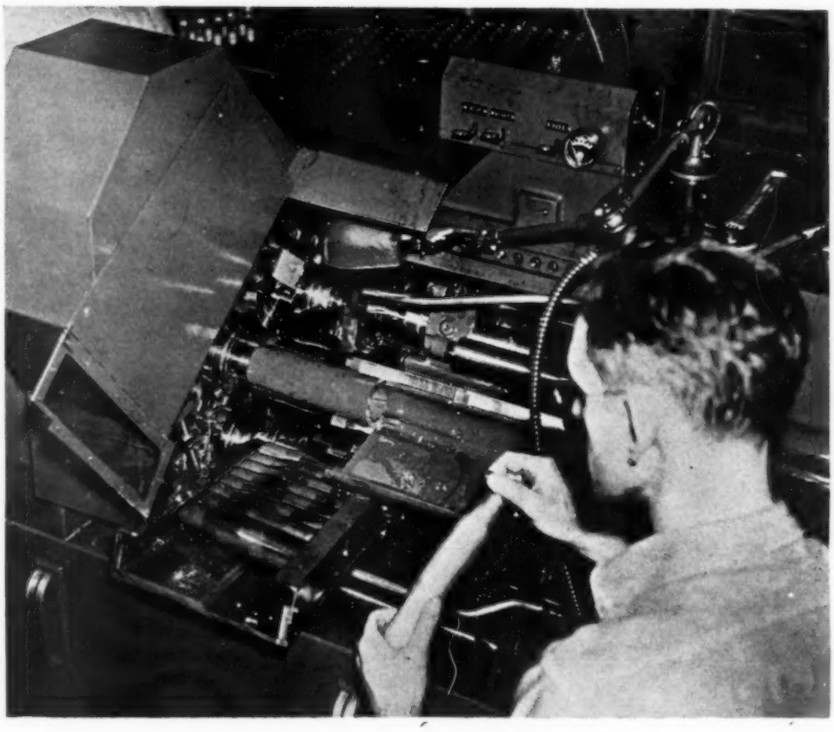
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

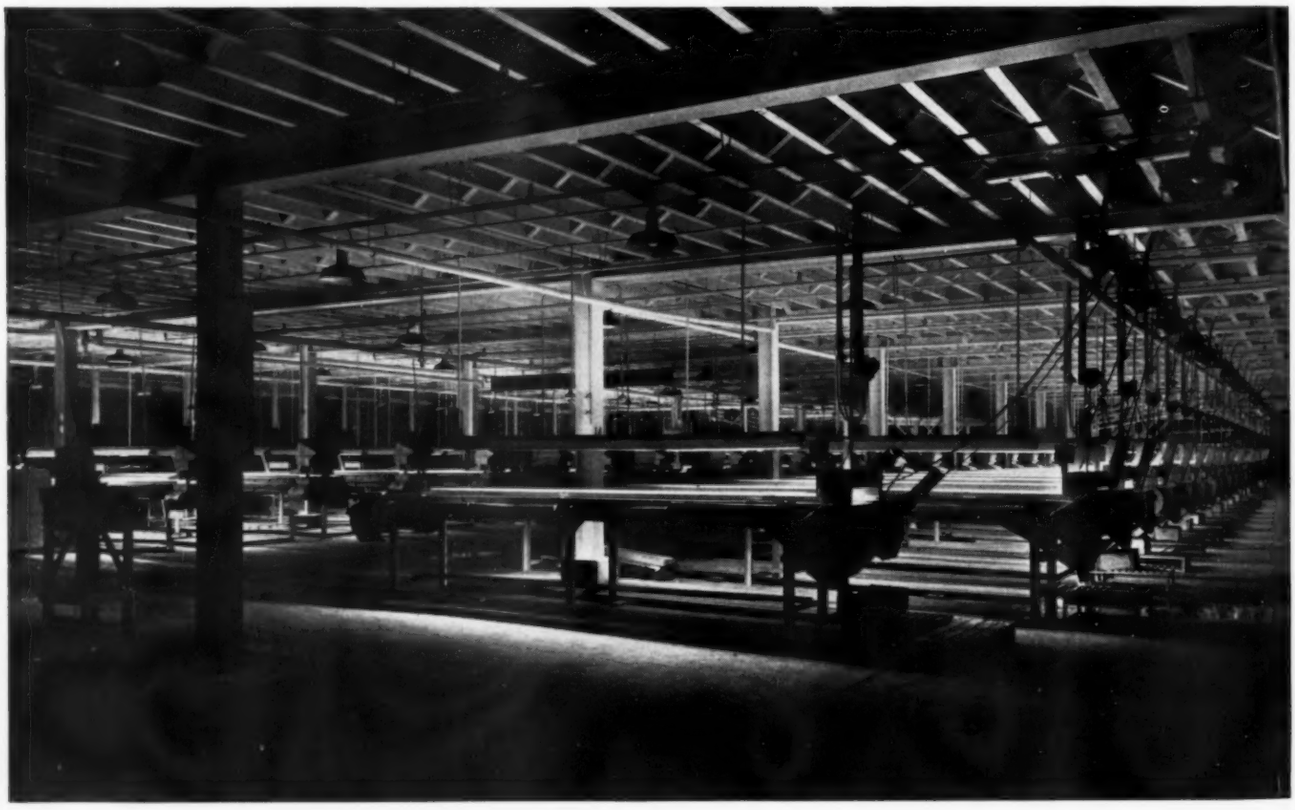
SPECIALIZED ILLUMINATION

LIGHT SOURCES CLOSE TO THE WORK PROVIDES HIGH ILLUMINATION LEVELS ON CRITICAL TASKS OR HARD-TO-REACH SPOTS.



LOCAL LIGHTING directly on the tool head is vitally important in some critical machine jobs. The adjustable arm and reflector puts an extra punch of light at exactly the right spot, and swings out of the way for tool changing.

CLOSE UP lighting troughs along these packing and sorting tables provides high intensities in the working area for critical seeing. Units are single lamp continuous fluorescent supported by conduit stems from the ceiling.



Load Center and Transformers Serve Lighting

[FROM PAGE 21]

This factory was to be operated on a three-shift basis and maximum production was desired. Fluorescent lighting was laid out for a design level of 50 foot-candles average in service. Wiring channels, located twenty feet off the floor and on ten-foot centers, were run the full width of each fifty-foot bay. To obtain the 50 foot-candle level desired, twelve 100-watt mazda F lamps and RLM reflectors were provided on each channel. During the first 100 hours of operation, lamps of this type experience what is known as an "initial drop" of approximately 10 per cent in light output, after which depreciation becomes quite gradual. The light output during life averages about 90 per cent of this 100 hour value. Allowance for this expected drop is made in designing lighting systems. Since this particular system was laid out for 50 foot-candles, it is interesting to note that several weeks after the plant had been placed in operation, measurements indicated that the lighting varies from 47 to 53 foot-candles.

Indoor Lighting Supply

The fluorescent lamps were laid out for power supply from single-phase, 37.5-kva., 480- to 120/240-volt air-cooled lighting transformers installed on columns every 40 feet along the length of the building. These transformers receive power from the 480-volt main feeders. Primary protection for the lighting transformers is obtained by the installation of a 600-volt fused safety switch between each transformer and the 480-volt main feeder to which it is connected. Secondary control of the fluorescent lamps is taken care of by a single contactor mounted on the same column with the lighting transformer and safety switch. By pushbutton control from the base of the column on which it is installed, each contactor is arranged to switch the lamps off and on in a section of the building 200-feet wide and 40-feet long.

Since this is an assembly plant, the power load is especially light. The main power loads consist of motors driving induced draft fans and two-stage air compressor motors in the heating plant, as well as crane, hoist, and unit heater fan motors in the factory. Motor loads of this kind are taken directly off the 480-volt feeder mains, while small single-phase motors for small tools, etc., are supplied from convenience outlets fed by the lighting transformers.

Make Better WIRE JOINTS Faster!

. . . AND CONSERVE CRITICAL MATERIALS

AVAILABLE NOW—"Wire-Nuts" do not use Lead, Tin and Rubber, as required for solder-and-tape joints; so their availability is not affected by shortages of these critical materials—and *your* work isn't delayed a minute.

Speed wiring jobs this fast, easy way. A pocket full of IDEAL "Wire-Nuts" and a wire stripper is all you need. The "Wire-Nut" threads onto the wire just like a nut on a bolt. Compare that with slow, messy solder-and-tape and you realize why contractors who use "Wire-Nuts" beat contract dates . . . And they get superior joints, neater, better electrically, stronger mechanically!

SIZES FOR EVERY JOB—For small conduit fittings as well as sizes large enough to join 3 No. 10 wires. FULLY APPROVED.

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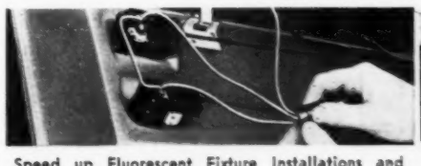
Wire-Nuts®
Solderless, Tapeless Wire Connectors



Speed up Fluorescent Fixture Installations and Repairs with "Wire-Nuts".

Roughing-in is greatly simplified with "Wire-Nuts". No danger of fires or burned woodwork.

Editorials

Metal Economy In Fluorescent Lighting

Under the strict limitations on the use of critical materials, fluorescent industrial units will be provided with non-metallic reflectors, considerably reducing the amount of steel required.

The actual metal economy in fluorescent lighting, however, lies beyond the fixture. On the basis of effective light output, they require less copper and steel in wiring systems, transformers, service equipment and power generation and distribution.

In these days, when power resources are being strained to capacity and wiring limited to essential needs to conserve copper, the ability of the lighting industry to provide additional illumination without excessive quantities of new capacity and wiring is tremendously important.

Lighting men have discouraged the sales approach of power bill economy in fluorescent lighting promotion. But that characteristic economy is now permitting urgently needed lighting improvement in converted industry. Better lighting from the same power resources is only a step toward really adequate illumination but a vitally essential one today.

Business Men In Government

The Truman committee's report that there was an avoidable delay in the conversion of industry to war work and its attack on dollar-a-year men holding executive posts in Washington is good vote bait for the coming elections. It is unlikely that it contributes much more than that to the war effort.

Actually the business man drafted into Washington service in these days is leaning over backward. Certainly mistakes have been made. In the critical analysis of hind-sight, defects in judgment and hesitancy toward drastic action are all too apparent. But why select any one group for criticism on these grounds. On the same charge we could indict many high administration officials, members of the armed forces, members of the House, members of the Senate and the public at large.

Unquestionably, the high ranking business men called to Washington should have certain foresight and the ability to predict the growing dislocations of war. They have. And their contribution to the war effort has been great indeed.

There is still a tremendous job to be done on conversion, especially in the linking of small business firms into the war effort. It will be done by capable business men turning their years of business experience into the service of the nation.

Summer Recesses

About this time of the year, many electrical trade associations recess for the summer months.

In normal times such a policy is fine. But, under wartime conditions, its justification is doubtful. Things happen fast these days—priorities change from day to day; substitute materials are cropping up; maintenance, field inspection and shop problems arise. All of them have a direct bearing on the promotion of our war effort.

A two or three month layoff is highly undesirable. We've got to keep in constant touch with these important developments in our respective fields. And the semi-monthly or monthly meetings are a means of doing this. Vacations are necessary, but they should be staggered so at least one man in the organization can attend such meetings.

We need these get-togethers more than ever before. Let's continue them intact for the duration.

Rubber Scrap

Everyone in the electrical industry has his own scrap rubber collecting job to do. Under the campaign which will reach into every cellar, attic and garage in the country we will accumulate a pretty fair picture of what our scrap inventory is.

There is one place where this industry has a special opportunity, however. The reclaiming of rubber from scrap wire is a tough job. The usual procedure has been to burn it off and junk the copper. If anyone has a practical method worked out for removing the rubber in a reclaimable condition they will be doing a service to their country by passing the idea along.

Send in your rubber salvage methods. We'll publish those which prove most practical.

Record Building Year Predicted

At the present rate of construction and with further increases in prospect the War Production Board anticipates a 13½ billion dollar construction record by the end of the year, 20 per cent over the all-time record set in 1941.

The construction industry is almost completely converted to war work. Of all construction, all but 22 per cent is for airfields, war plants, camps, shipyards, war housing and similar war connected projects.

Whatever drastic materials economy must come in electrical construction work the total demand is still increasing with no let up in sight for 1942.

The drain on critical materials represented by this tremendous program is obvious. It is an urgent responsibility on our industry to make the most of what we have and conserve wherever we can.

A New Field

Ship wiring is blossoming out into a new and important field for the electrical contractor. For years this work has been done by the yard crews. But, due to the increased amount and complexity of the wiring systems and the production rush, yards are now contracting this work.

Shipyards are finding it difficult to get competent electricians and they are glad to unload this responsibility and problem to the electrical contractor. A few contractors have made their initial venture into this direct from yard wiring, and are finding it profitable.

Are Reduced Standards Permanent?

If we compromise with our standards of quality, permanence and future capacity for metal economy, what about the post war period? Can we restore those standards which we have brushed aside for the duration?

Nobody can call the answers definitely, but this we all know—the wiring systems of the post war period will naturally adopt the methods that prove out now. They will be less inhibited by traditional tools, they will certainly be better, more adequate and more complete.

Right now we can't use a lot of materials that good design would indicate as highly desirable—ample future capacity in copper, for instance.

Once the limitations are relaxed and materials are once more available we shall use them more liberally than ever before. This is normal, it happened after the last war, it will happen again.

Baby Joint Ventures

Defense housing is now one of the most important phases of our wartime construction program. Thousands of units are being built in defense areas throughout the country. But still we hear of house wiring contractors going out of business for the duration.

Indianapolis contractors are not taking this lying down. They are working out a plan for joint ventures on this work. They have the experience and talent for this type of wiring and they can easily work out mass production techniques.

There is no apparent reason why ventures of this type won't work. It's being done every day on large war plant construction. It is a house wiring technique that can be inaugurated now and carried through in peace time.

Understanding Priorities

Considerable confusion appears to reign among the trade concerning priority ratings and limitation orders. How do they apply? What information is wanted? How should the forms be filled out? All this leads to delays and makes it doubly hard for officials to issue proper ratings.

A Memphis electrical contractor and shop man has a simple solution. "There's nothing difficult about priorities," says he, "you just keep up on the rules, study them carefully and do just what they tell you."

This is good sound advice. Too often, we let orders and changes pile up, then hurriedly rush through them to digest all the regulations. Too often, we apply our own individual interpretations. And, in some extreme cases, we further confuse the issue by looking for loopholes that will favor us. Small wonder that we become muddled.

Let's heed our Memphis friend's advice and try his solution. That shouldn't be difficult.

A Lease on Life

The smaller and medium sized electrical contractors in the Chicago area saw the handwriting on the wall when priorities and allocations began to pinch. And they did something about it.

They went to school for 20 nights to learn the in's and out's of systematic estimating, with particular emphasis on industrial work. Many of them were residential, apartment and commercial wiring specialists.

Now they know how to figure industrial work and are all set to do wartime and post-war conversion work. Many have already landed sizable contracts.

This group could have surrendered without a struggle. But they took it upon themselves to gain this new lease on life. They have made themselves a stronger link in the electrical construction industry and have increased their versatility. Our industry needs more of this.

Back Talk

Priorities Needed

To the Editor—"I have just read in your June issue of *Electrical Contracting* an editorial about the needs for a modified PRP for electrical contractors. I have written several letters to the War Production Board about this matter, but they do not seem to be aware of the hazards they are creating and the delays they are causing in interrupted production. We have been operating under an A-10 rating on repairs good up until June 30, but since the freezing of wire we have not been able to procure these supplies and have any number of jobs in hazardous condition that we are unable to correct.

"The local contractors here are gradually quitting this class of work and we can now serve about 25 percent of the calls for service.

"As one individual I can have very little effect with the few letters I write regarding this subject, and feel that this matter should be given more publicity as I believe that economizing on urgent repair material for our industry, will destroy much more property and stop more production of strategic value than the small amount of copper saved can justify."

Eugene W. Clower
Clower Electric Shop
Dallas, Texas

It is possible to obtain any justifiable priority assistance for specific projects through the help of the local or regional WPB offices. Special cases where there is no regular routine available can always be handled through a PD-1A application by the owner. However, such procedure involves a time delay that can prove disastrous when electrical hazards are involved.

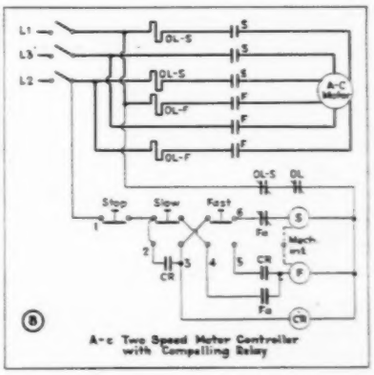
The modified PRP rating suggested in our June editorial is a logical answer to the problem. It would permit small stocks of essential materials to be maintained in stock for urgent use. It is practical. It would permit just as careful control of and use as under present conditions. And it would allow the contractor to start work at once on emergency calls or when hazards show up.

Beg Pardon

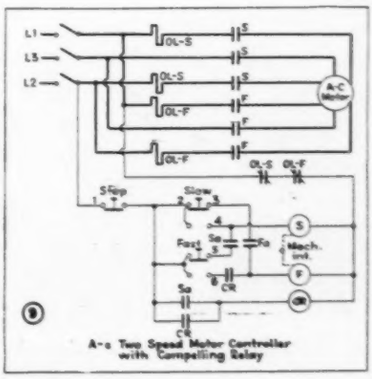
To the Editor—"Two errors appear in the diagrams on page 25 of your June issue. In figure 8, there should be no tie between the slow and fast buttons as shown. In figure 9, there should be a cross tie to the contact on the fast push-button."

Hendley N. Blackmon, Mgr.
Editorial Service
Westinghouse Elec. & Mfg. Co.
East Pittsburgh, Pa.

Our apologies to Mr. Immel. The corrected diagrams are shown below.



A-c Two Speed Motor Controller with Compelling Relay



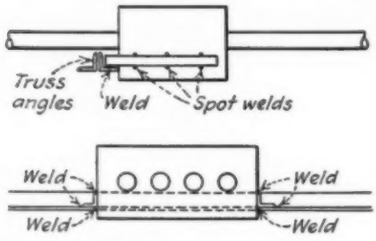
A-c Two Speed Motor Controller with Compelling Relay

WIRING Methods

WELDED PULL BOX SUPPORTS

Electric welding was used extensively for mounting panels and pull boxes by the Associated Electric Construction Company, Melrose Park, Ill., joint venture electrical contractors on a large defense plant construction job.

The accompanying sketch illustrates the method used to mount pull boxes in the lighting feeder circuits. Two angle iron arms were spot welded to the sides of the pull boxes. These arms rested on and were welded to the truss angles in such a manner that the conduits entering and leaving the boxes lay on top of these angles.



***SPOT WELDS** rigidly fasten mounting brackets to lighting pull boxes and roof trusses. Work is expedited by eliminating extensive punching and drilling of steel boxes and trusses.*

Six spot welds were used to hold each angle iron arm to the box sides; three were used to fasten each arm to the trusses, as shown in the sketch.

Welding materially speeded up the construction work, eliminated the necessity for punching and drilling the trusses and boxes and made a substantially more rigid support.

TRANSFORMER LAYOUT

A combined switchboard room and transformer vault layout at the Physical Science Building of the University of Kansas is partitioned by a dead front switchboard. Front and back of the board are accessible through separate doors.

The Wetherbee Electric Co. of Oklahoma City, installed three 200 kva., single phase transformers, connected in closed delta, on a concrete platform at the rear of the vault. Secondary interconnections are terminated at an enclosed 4,000 amp. bus by a feeder which drops from the ceiling to approximately the level of the secondary terminals on the transformers. All connections, lugs and exposed ends of the bus are heavily taped.

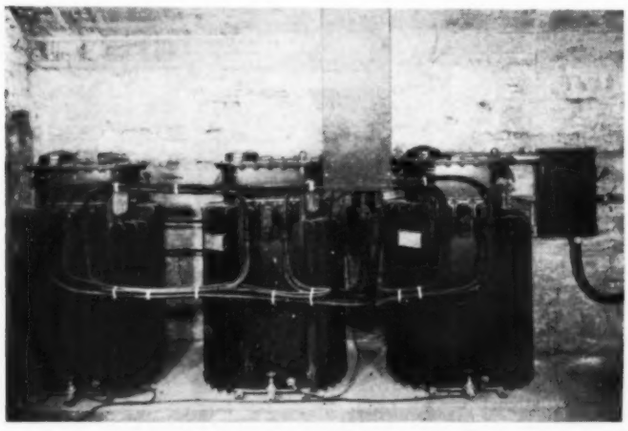
The busbar feeder extends 20 ft. to the main lugs on the dead front switchboard. Distribution feeders are protected and controlled by pull-out type switches and fuses. The switchboard forms a wall between the two parts of the vault.

SPLIT COUPLINGS FOR TIGHT PLACES

The use of ordinary split couplings proved to be an economical solution to the problem of installing six 6-inch conduit lines, each with two 90 degree bends, through a brick wall into a large switchboard room. This method was used by the Hixon Electric Co., electrical contractors and engineers on a commercial installation.

***SPLIT COUPLINGS** held by encircling steel bands provide means of joining offset conduits in restricted spaces. Conduits shown are of 6-inch size.*

The conduits were suspended from the basement ceiling, running in a horizontal plane, parallel to the brick partition, then turning at right angles and going through the partition and turning down to enter the top of the switchboard. There was no room to screw on the elbows and threadless and Erickson couplings in this large size are costly.



***TRANSFORMER SECONDARIES** feed enclosed bus bar connection to main switchboard.*

***DEAD FRONT** type of switchboard forms a partition between the transformer vault and the switchboard room.*

PORCELAIN
Protected
WIRING SYSTEMS
Give you every practical feature for today's important wiring jobs
★ CORROSION PROOF
★ RUST PROOF
★ SHORT PROOF
★ FIRE PROOF
★ SHOCK PROOF
BULLETIN
War Production aided through Electrical Industry's use of All-Porcelain Boxes. Action releases vital metals for war effort.

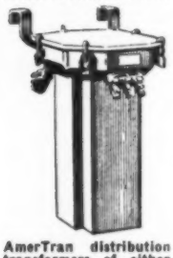
★ Three things to remember about porcelain are — 1. *Porcelain* is not classified as a critical material, therefore it is available now. 2. *Porcelain* has been used in wiring—both commercial and residential—for the past fifty years. 3. *Porcelain* is safe, durable, easy to install, economical in the long run of service.

Porcelain Protected Wiring Systems are getting enthusiastic approval both from contractors and their customers as the use of these modern systems continues to grow. You as a contractor do a two-fold job in using Porcelain—you conserve such critical materials vital in our victory effort as steel, zinc, copper, and rubber—you insure durable wiring jobs for your customers, giving them the benefit of numerous cost savings.

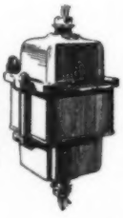
You can meet all of your immediate wiring needs now with the knowledge that you will get the most modern results by using PORCELAIN. Your wholesaler can supply you. The companies listed below manufacture modern porcelain protected wiring systems.

AmerTran is improving its product to meet the exacting needs of today . . . tomorrow you will reap the benefit.

AmerTran power transformers available for all requirement in sizes to 10,000 KVA., 132 KV.



AmerTran distribution transformers of either oil or non-inflammable-liquid immersed type available in sizes to 500 KVA., 72 KV.



AmerTran air-cooled transformers for either indoor or outdoor service are available for all industrial requirements — sizes to 150 KVA.

TODAY . . . our entire plant output is being devoted to one purpose . . . to help win the war. Transformers of every type and description are being required in larger quantities than ever before, not only by government departments but also by defense plants and electric utilities. AmerTran is doing its share to meet this demand . . . we are developing improved designs and improved manufacturing methods . . . we are increasing our personnel and facilities . . . in short, we are shipping more and better transformers.

TOMORROW . . . when our bombers pull victoriously out of their last dive, the resumption of peace time demands will find AmerTran equipment far better than ever before. During these days when customers without priorities are deprived of transformers, we are supplying the exact same type of product as previously, and are developing improvements at a more rapid rate than usual. Customers of the future will benefit from these developments.

AS for the past 41 years, AmerTran will continue to hold the place of leadership in the communication field it has gained by the high excellence of transformers supplied for all electronic and radio applications. Manufacturers with sufficient priority rating are invited to discuss their transformer requirements with us now . . . all others must wait for victory.

AMERICAN TRANSFORMER CO.,
178 Emmet St., Newark, N. J.
Manufactured Since 1901 at Newark, N. J.

AMERTRAN

AmerTran Transformers are built to meet your exact Electrical and Mechanical requirements.

WIRING Methods

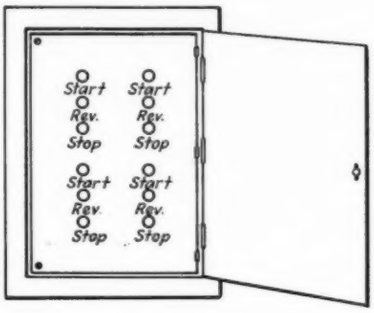
[FROM PAGE 102]

So ordinary conduit couplings were split on two sides by a hack saw, placed over the threaded joints and brought up tight with two encircling bands of flat iron bolted together at the top of the conduits. The resulting joint is rigid, secure and provides a good bond for ground continuity.

CABINET MOUNTED REMOTE CONTROLS

The remote control buttons for electrically operated garage doors in a large plane plant were flush mounted in a door-in-door cabinet by the John Miller Electric Company, Detroit contractors.

The control pushbuttons are flush



DOOR-IN-DOOR cabinet houses gang-mounted remote control buttons for electrically operated doors. Construction can be made watertight by use of proper gaskets.

mounted in gangs of four or more on a hinged sheet steel cover which, when closed, conceals all the control wiring. When open, it permits easy access to the wiring and facilitates maintenance. The outer door of the cabinet encloses the entire assembly and can be made watertight by the use of suitable gaskets.

SHAKER SCREEN RESISTANCE HEATED

By using the resistance of the iron wire in a screen and designing a transformer to operate through it to produce a heated screen, improved operation and lengthened life were given to screening of clay for a brick company in Los Angeles by Quality Electric Co., Ltd., contracting and motor house in that city.

Clay ordinarily contains enough moisture to clog the screens and re-

For any wartime layout

Q-FLOORS PROVIDE ADEQUATE WIRING

War calls for QUICK MOVING. New office layouts are wanted overnight. Machinery must be moved frequently . . . so must electrical floor outlets . . . to keep pace with the new demands in war production.

QUICK-CHANGE Q-FLOORS . . . that eliminate the digging of trenches every time electrical floor outlets must be moved . . . make desk moving and machine moving, a simple, easy and economical operation. Q-Floors consist of parallel wiring raceways on 6-in. centers over the entire floor area, which provide easy access at any point where a floor outlet is desired. Q-Floors assure 100% electrical availability.

***"Adequate Wiring"* Needs Unlimited Raceway Capacity**

Greater profit for the electrical contractor is another Q-Floor advantage. Q-Floors cut down overhead by keeping crews on the job continuously. There is no reduction in productive labor and materials. Read the "G-E" Announcement opposite.

H. H. ROBERTSON COMPANY
FARMERS BANK BUILDING • PITTSBURGH, PA.

Announces

ROBERTSON

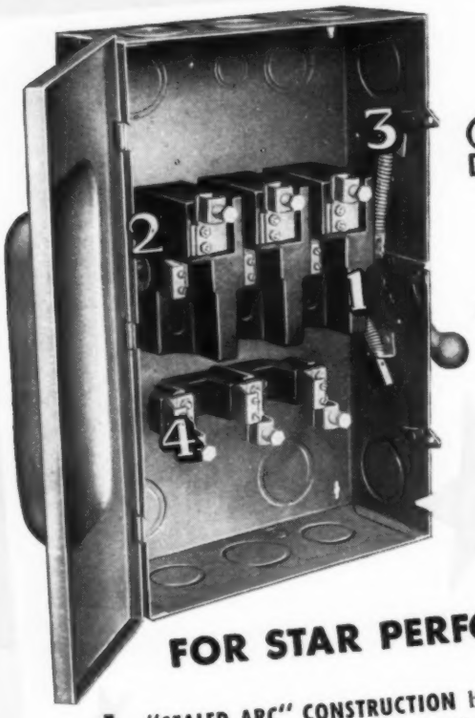
Q-FLOOR

ELECTRICAL FITTINGS

For information about these fittings and how they are used to obtain adequate up-to-date electrical wiring—get in touch with your nearest "G-E" Merchandise Distributor.

ROBERTSON Q-FLOORS

FEDERAL
ELECTRIC PRODUCTS



Sealed Arc
SAFETY SWITCHES
FOR INDUSTRY

Star features
FOR STAR PERFORMANCE

1 **"SEALED ARC" CONSTRUCTION** barricades switching arms behind porcelain to minimize effects of arcing, assure long life for contacts.

2 **VERTICAL-RIBBED ARCING CHUTES,** lining interior chamber of switching block, break up and snuff the arc. An exclusive Federal feature.

3 **STURDY QUICK-MAKE, QUICK-BREAK** spring mechanism.

4 **PATENTED "VISE-CLAMPS"** grip fuses tighter than old-fashioned spring tension, prevent heating.

These are but four of the many features that make Federal "Sealed Arc" Safety Switches favorites for every industrial application. Use them for trouble-free operation on your essential circuits.

For Complete Safety Switch Data
write for Bulletin 21-40-S. Contains all essential facts on Types A, C and D Federal "Sealed Arc" Safety Switches.

FEDERAL ELECTRIC PRODUCTS COMPANY, INC.
50 PARIS STREET, NEWARK, N. J.

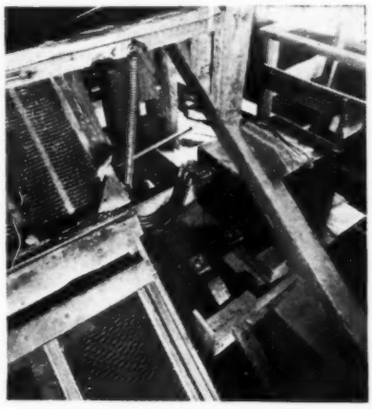
Follow the Federal Line
PANELBOARDS • SWITCHBOARDS • SAFETY SWITCHES • CIRCUIT BREAKERS

WIRING Methods

[FROM PAGE 104]

quires frequent beating to clear it. Such beating shortens the life of the screen and slows production. Atkinson Brick Co., Los Angeles, appealed to Quality Electric for a solution. The latter measured the resistance of the iron wire screen, calculated the amount of heat required to evaporate the moisture and built a 25-kva., air-cooled transformer with 440-volt primary and secondary to give some 1,800 to 3,000 amp., using the screen itself as a heater. As shown in the illustration, the upper screen is at an agle of about 65 deg. and is about 30 per cent clogged with damp clay. The lower screen is at 45 deg. and is clean.

With a screen 3- by 8-ft. and normal moisture content, 18 kw. were required for perfect operation. Transformer secondaries were connected to the screen



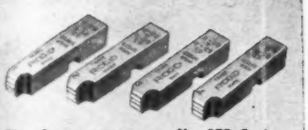
TRANSFORMER attached to lower screen in temporary test hook-up. Note the cleanliness of the lower screen as compared to the upper one not heated.

through extra flexible leads attached to either end from a 1- by 3-in. copper bus. Screens operate at black heat.

Before installation of the electrical method, four to five new screens per month were required, costing $7 each. Labor cost of replacement and screens averaged $1,000 per year. High mortality was due to necessity for frequent heating and an attendant was also necessary at an annual cost of $1,560.

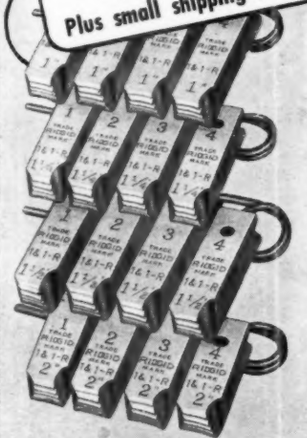
With the electrical method it was indicated the screen would last at least a season, from rainy season to rainy season, attendants would be eliminated and savings amounting to $2,560 per year effected. Production increased 15 per cent or from 95,000 bricks per day to 109,000 with no additional help. Prior to the change, the extrusion machine and other equipment following the screening had greater capacity than screens. Afterward it was necessary to speed the latter machines 11 per cent.

A New Service to keep your RIDGID Pipe Tools on the job



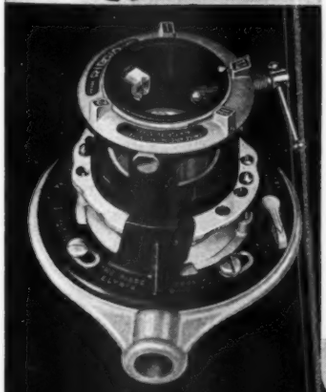
Dies for RIDGID No. 65R Series

Your RIDGID dies Factory Reconditioned **44¢** PER SET OF 4 Plus small shipping charge



Dies for RIDGID No. 1R Series

Dies for RIDGID No. 00R, 0R, 11R and 3-way Series



FACTORY RECONDITIONING of RIDGID Wrench Jaws and Chaser Dies

Big Saving To You, New Parts Guarantee

No Priorities Needed

This Service Available Only in U. S.

Here's What You Get

1. Careful inspection of the parts you send us, to make sure they are worth reconditioning. We reserve the right to reject them for service if they can't be made as good as new.
2. Wrench jaws to be scientifically annealed in our automatic electric furnaces, same as new jaws.
3. Wrench jaws to be recut in the same machines and by exactly the same methods as used for new jaws. Chaser dies are accurately re-ground to original specifications.
4. Wrench jaws are then rehardened, like new.
5. Both wrench jaws and chaser dies are given final inspection—and returned to you under regular RIDGID new part guarantee of satisfaction.

Here's What You Do

Collect all your old worn RIDGID Wrench Jaws and Chaser Dies and turn them over to your Supply House with order for this Reconditioning Service. Your Jobber ships them to us with parts accumulated from other customers, to save shipping expense, for we allow one-way freight to Jobber on lots weighing 100 pounds or more. Remember: *only* RIDGID *trademarked parts accepted for service.* No priorities needed. Service is prompt. Keep your RIDGID Tools on the job—order today.

THE RIDGE TOOL CO. ELYRIA, OHIO

RIDGID

Pipe Wrenches, Cutters, Threaders, Vises

Your RIDGID wrench jaws Factory Reconditioned **½ PRICE** OF NEW PARTS Plus small shipping charge

RIDGID Wrench Hookjaw

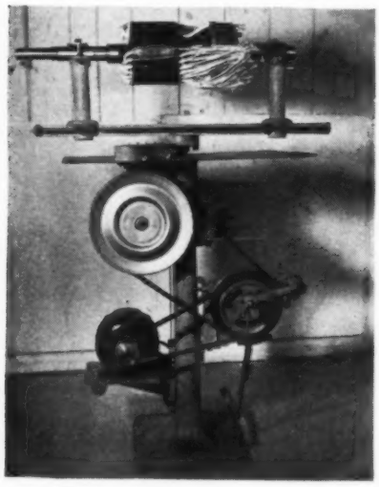
RIDGID Wrench Heeljaw with pin

Work-Saver Tools for America's Big Job in 1942

Motor Shops

ROTATING ARMATURE WINDER

A winding machine for large armatures, up to 15 hp. in size, which has a supporting armature yoke that rotates in a horizontal plane has been developed by and used in the motor repair shop



***ARMATURES ROTATE** at the touch of a foot, on this winding machine designed to facilitate armature rewinding. It will accommodate armatures up to 15 hp in size. One shown is for a 3 hp, 1200 rpm motor.*

of A. L. Brown Associates, Inc., Worcester, Mass.

The rotating mechanism consists of a horizontal square steel member on which slide two vertical supports that cradle the armature. These two supports are adjusted for shaft length by turning a long threaded shaft to which they are connected. Once the adjustment is made, the armature is rigidly held by two-bolt straps on each vertical piece.

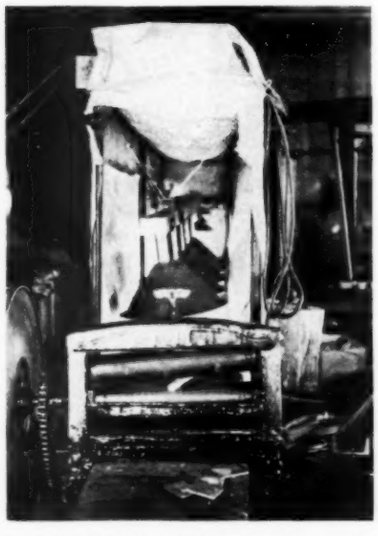
This entire yoke is connected to a vertical shaft which is operated through reduction gears by a combination of belt driven pulleys, clutch and motor. The armature winding head rotates at a speed designed to facilitate the winding operation. A foot pedal actuates a clutch so the winder's hands are free.

INFRA-RED "TUNNEL" FOR LAMINATIONS

W. S. Belt, superintendent of the Wolff Electric Co., Portland, Ore.. has constructed an infra-red drying "tunnel" at little cost though nevertheless effective for drying transformer core laminations. The tunnel part is approximately ten feet long, made of canvass stretched over a light frame.

In the top of the tunnel is mounted a row of eight 250-watt infra-red drying lamps with down-pointing reflectors as seen in the photograph. Beneath them travels a belt made of steel wire mesh with openings of about one-half inch. This belt is a foot in width. It runs the full length of the tunnel and the forward end projects about a foot outside the canvass. Over this projecting end of the belt is an ordinary clothes wringer mounted so as to deliver onto the belt. The wringer is rerigged so that the lower roll runs in a trough of varnish.

In operation, the lights are turned on and a man feeds the small metal plates through the wringer, which drops them neatly varnished on both sides, onto the belt. The belt drive is so geared that about one minute is required for the passage of a piece under the lamps, and they are delivered at the other end perfectly dry. A three-quarter horsepower motor furnishes the power, through V-belts and suitable countershafting for speed reduction, for both belt and wringer.

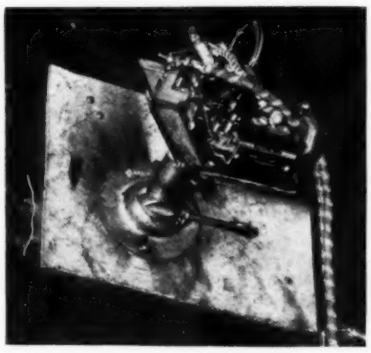


***DRYING TUNNEL** of infra-red units over conveyor does a 60 second drying job on varnished transformer core laminations.*

CRITICAL OVEN CONTROL

Paul G. Winter, manager of the American Electric Company, motor repair organization of Indianapolis, Indiana, has equipped his gas fired bake oven with an automatic regulator that gives plus or minus three degree heat control at the equipment placed in the oven.

The thermostatic equipment consists of a General Electric CR2992-R1 standard heat control with a five-foot tube extending inside the oven. This tube is adjustable to any desired position in the oven. It is held in place by a ¾-inch close nipple, equipped with a thumb screw and mounted to an ordinary lighting fixture aligner. The aligner, mounted to a piece of sheet asbestos on the side of the oven, also has a thumb screw arrangement so the tube might be held rigid at any desired angle.



***ADJUSTABLE MOUNTING** at the relay end of the thermostatic tube is provided by a close nipple and an ordinary fixture aligner, equipped with thumb screws for locking tube in position.*

The end of the tube is placed at the center of the armature or stator in the oven. The relay connected to the tube at the outside of the oven is equipped with a temperature setting indicator that was slightly modified for close regulation. This mechanism, in turn, operates magnetically controlled by-pass valves on the gas burners. When the oven temperature is low, maximum gas flow is permitted; when the oven is too hot, minimum flow is allowed.

SOME HOMELY TRUTHS ABOUT

HORSESHOES and HORSEPOWER

MAYBE THE VILLAGE SMITHY WAS A MIGHTY MAN.

BUT IT MADE LITTLE DIFFERENCE $\frac{2}{28}$. IF THE HORSESHOES HE MADE DIDN'T

EXACTLY FIT, THE HORSE COULD STILL DO JUST AS MUCH WORK.

BUT ELECTRICAL HORSEPOWER IS DIFFERENT MOTORS MUST BE

MADE WITH MICROSCOPIC ACCURACY TO PERFORM YEAR AFTER

YEAR WITHOUT ATTENTION . . . FOR EXAMPLE, WESTINGHOUSE MANUFACTURES

A SPECIFIC MOTOR TO FIT EVERY JOB . . . YOU DON'T DEPEND ON LUCK

WHEN YOU CHOOSE A WESTINGHOUSE SMALL MOTOR YOU GET

PREDETERMINED PERFORMANCE BASED ON ADVANCED ENGINEERING SKILL MODERN

MANUFACTURING METHODS, AND A THOROUGH STUDY OF YOUR NEEDS.

J-03167

Westinghouse

SMALL MOTORS

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PENNSYLVANIA

LATROBE

FLOOR BOXES *and* WIRING SPECIALTIES

No. 280
NOZZLE

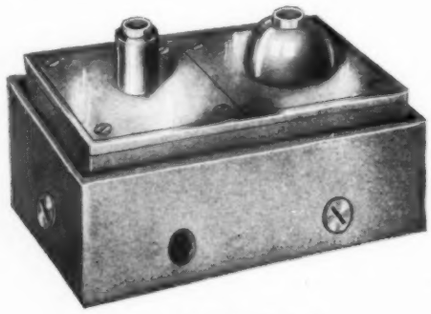
In No. 200 Cover Plate Ten Amp. 250 Volt receptacle in Brass Housing, mounted on ½ in. brass pipe extension 3 in. long.

In war production, *time* is of vital importance. Rush jobs are frequently necessary to keep vital products flowing off production lines. In such emergencies the use of Latrobe Products are definitely helpful in decreasing time necessary for installation.

The Latrobe line includes the most approved types of Floor Boxes and Wiring Specialties for industrial, commercial and residential jobs.

No. 285 NOZZLE
for Floor Outlets

Double duplex receptacle Nozzle in No. 200 Coverplate. ½ in. brass pipe extension. Furnished also in ¾ in. pipe extension.



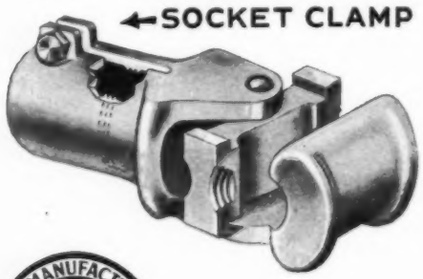
No. 252-R FLOOR BOX
with Nos. 206 and 207 Nozzles

Provided with solid partitions to separate low and high tension wires. Minimum height to top of Coverplate 3½ in. Box bodies 3 in. high. Shallow boxes when required.

No. 400
"BULL DOG"
INSULATOR
SUPPORTS

Malleable iron of high tensile strength for fastening porcelain and glass insulators to exposed steel framework.

←SOCKET CLAMP



No. 625 CONDUIT BENDER

A combination ½ in. and ¾ in. Conduit Bender with reversible jaw. Deep socket for 1 in. pipe handle. Socket Clamp prevents possibility of handle working loose or breaking off.

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE OB SUPREMACY LATROBE, PA.

Check your stock and let us know your requirements. We will make every effort to ship when wanted.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

Motor Shops

[FROM PAGE 108]

The oven is also equipped with an automatic timing device that shuts off the gas after a predetermined baking period. It also makes a tape record of the temperature regulation throughout

AT THE WORK control of bake oven temperatures is provided by using this long tube thermostatic arrangement for regulation gas flow. Tube can be adjusted to any desired angle.

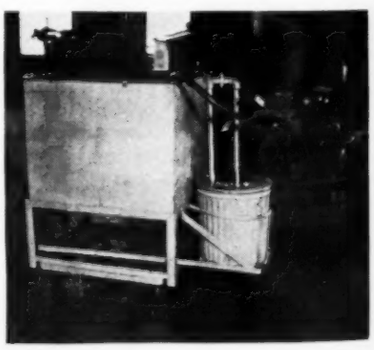
the baking operation, showing the high and low values.

Previously, average oven temperatures were used to regulate baking heats. Now, much more critical control of the baking process is obtained by using "at the work" temperature control of oven firing.

PORTABLE CLEANING TANK

A portable steel cleaning tank that will accommodate any size motor frame up to 50 hp., 900 rpm, was built by A. L. Brown Associates, Inc., for use in their motor repair shop at Worcester, Mass.

The tank is a self-contained cleaning unit that can be easily moved to the work. The square washing tank, which



MOBILE UNIT consisting of a tank and pumping mechanism saves cleaning time, labor and energy in this Worcester motor repair shop. Requires only three gallons of cleaning fluid.

APPLETON CAST MALLEABLE "UNILETS" AND ALL APPLETON CONDUIT FITTINGS

Take Bumps and come back for more!

Drop 'em! Hammer 'em! Twist 'em! Give them any of the punishment that fittings are apt to meet on a rush war-construction job! Appleton Malleable "Unilets" and all Appleton fittings will take it in stride!

They save time; they eliminate loss due to damage or breakage; they provide the modern, extra margin of safety so important on many of the jobs being done today. Their superiority over fittings made of any other material has been proved on thousands of jobs—a superiority more important now than ever before.

The vast Appleton line answers *every fitting requirement* from simple steel outlet and switch boxes to big, heavy-duty explosion-proof types. All of the thousands of types and sizes are manufactured in Appleton's own plants and foundries under one unified quality control.

Make ordering easier; have the right fitting for every installation; simplify inspection—specify "Appleton" on every fitting order!

SOLD THROUGH WHOLESALERS

APPLETON ELECTRIC COMPANY
1704 WELLINGTON AVENUE CHICAGO, ILLINOIS

Branch Offices: NEW YORK, 76 Ninth Avenue • DETROIT, 7310 Woodward Avenue CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 203 Luckie Street, N.W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S. • PITTSBURGH, 418 Bessemer Bldg.

Resident Representatives: Baltimore, Boston, Cincinnati, Dallas, Denver, Kansas City, Milwaukee, New Haven, New Orleans, Philadelphia, Seattle

APPLETON

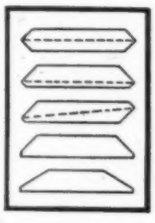
CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

The SPEEDY

ARMATURE SLOT WEDGE OR KEY BEVELER

OFFERS YOU RAPID, ACCURATE SAWING AND BEVELING OF WEDGES OR KEYS USED TO RETAIN COIL WINDINGS IN THE CORE SLOTS!

- CUTS ANY BEVEL . . . .
- SAWS ANY WIDTH . . . .



Edge bevels of any angle can be made by a simple change of cutting tools—takes less than a minute. Any combination of edge bevels can be made. Special saws for wedge material are furnished for cutting to proper width at no additional cost.

FOR ANY SIZE MOTOR OR GENERATOR

Using fibre, bakelite, wood or any other insulating material, the SPEEDY Beveler speeds repair work 50% to 75%. Eliminates cost of ready-made wedges—can be operated by any shop employee.

Adjusts to Any Width or Thickness

SPEEDY is sold with two cutting tools for standard 45° bevel and one Special Saw for cutting wedge material. Operates best with 1/3 H.P. motor. Sold less motor.

For Complete Data.... MAIL THIS COUPON

YOUNGSTOWN SERVICE PRODUCTS CO., INC.
YOUNGSTOWN OHIO

Gentlemen:
Please send me detailed information covering the SPEEDY ARMATURE SLOT WEDGE OR KEY BEVELER.

Name .....
Company .....
Address .....
City..... State.....

Motor Shops

[FROM PAGE 110]

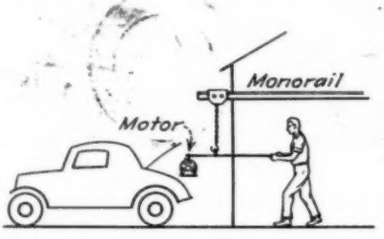
is 24-in. by 24-in. by 30-in., is mounted on an angle iron box frame which rests on four casters. The pressure mechanism consists of a five gallon cylindrical reservoir for the cleaning fluid, anchored to the side of the washing tank by a supporting framework.

This fluid tank is equipped with a ⅙ hp. vertical pump motor which forces the fluid through an ordinary garden hose with a spray nozzle into the washing tank. A by-pass valve arrangement regulates the fluid pressure. The cleaning fluid returns to the reservoir after passing through a dirt trap in the washing tank. Thus the same fluid can be used over and over again. About two to three gallons are necessary to efficiently operate the unit.

The introduction of this cleaning unit in this repair shop has considerably cut the cleaning time, confined all dirt and splashing within the tank and eliminated the necessity of moving heavy equipment to a stationary cleaning point.

MOTOR LIFTER

"Many farmers, and mine owners," says Frank Andrews, of Andrews Motor Works, Modesto, Calif., "bring their motors in for repair in their coupe, two and four door cars. To get them out was a job. Skinned knuckles and some



LOADING RIG for handling motors in and out of automobiles saves shins, temper and paint jobs. An extension lever hooks to the motor and hoist.

bad under-breath talk were common. So we made up a bar with an eye and hook which has worked out very nicely."

As shown in the drawing the bar has a hook at the end to pick up the motor, an eye to act as the fulcrum of a lever when it is attached to the monorail hoist hook, and sufficient bar length to provide good leverage. With this gadget motors up to 20 hp. can be handled easily, lifted into or out of cars and through car doors.

How to save time by doing more reading

That is a profitable paradox for you. More true today than perhaps ever before. For here in the pages of this publication are packed many helpful ideas . . . considerable useful information. Much of it, in fact, available from no other source.

And we most emphatically mean *both* the editorial and the advertising pages.

Just one new idea gleaned from these pages . . . a method for doing something better or faster or easier or at lower cost, may alone save you far more than a year's reading-hours invested in this and other worthwhile business papers.

Many people have found this a fact . . . not only once, but time and time again. That's significant . . . with time so precious today.

★

Good advertising speeds information from those who have it . . . to those who need it.

★

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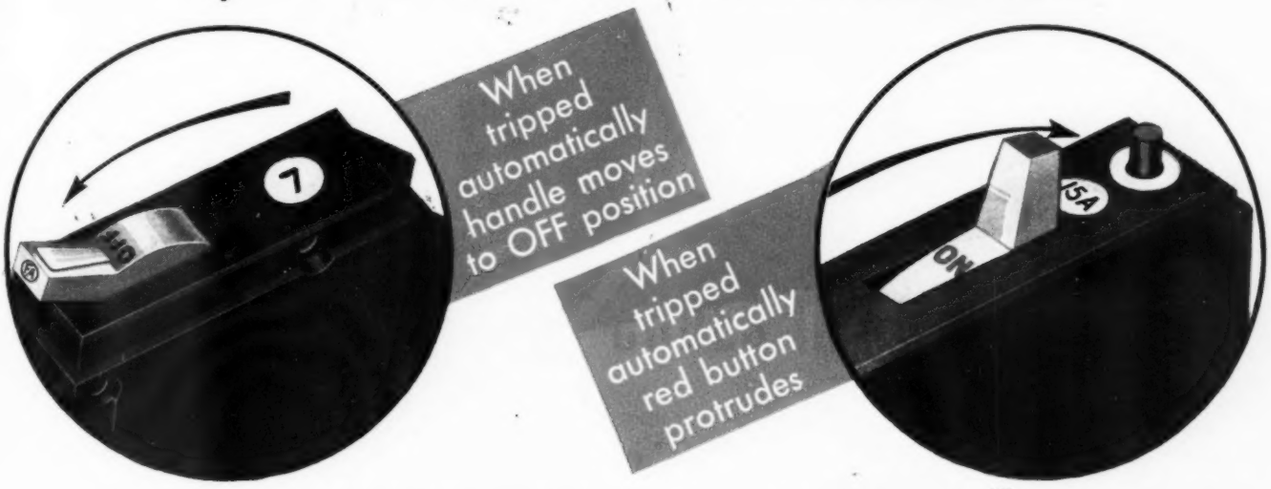
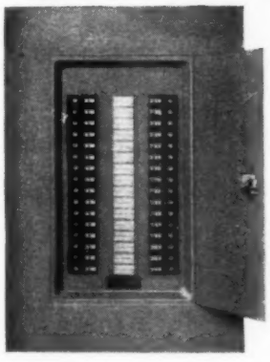
Both give you *automatic* protection

against abnormal load conditions!



Type AC Circuit Breaker
PANELBOARDS

Dublbrak Circuit Breaker
PANELBOARDS



for Lighting and Appliance Branch Circuits

Assembled from standardized units, with 4 to 42 branches.

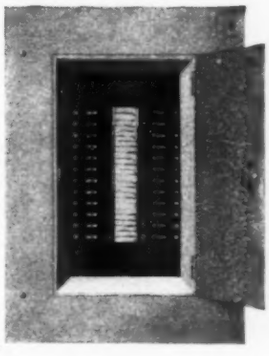
Capacities: 15 to 50 amps., 120 volts AC only, single pole.

At left: *Type AC Circuit Breaker Panelboard and Cabinet (Cat. No. NAC1B32-3L100), with 32 branch circuits.*

Assembled from standardized units, with 4 to 42 branches.

Capacities: 15 to 50 amps., 125 volts, single pole, or 250 volts, double pole, AC or DC.

At right: *Dublbrak Circuit Breaker Panelboard and Cabinet (Cat. No. NA1B24-3L100), with main lugs only.*



In both Types

of Circuit Breaker Panelboards, annoying interruptions of service from momentary overload are prevented by proper time lag characteristics. Protection against short circuit or harmful, sustained overload is assured — *the current is broken automatically before it can build up to a dangerous volume* . . . Installation is facilitated by new and improved terminal connectors — wide gutters — and ample knockouts in steel boxes . . . The fronts are bonderited to prevent rusting, then attractively finished in pearl gray lacquer.

Write for Informative Bulletins

Bulletins 57 (Dublbrak) and 62 (AC) contain complete descriptions, dimensions and prices, with wiring diagrams and suggested specifications . . . Frank Adam Electric Company, St. Louis, Mo.

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WHEN YOU... Wipe them regularly so they are free from oil, grease and chemicals. Such agents attack rubber and shorten its life.

WHEN YOU... Keep them out of light and sunshine as much as possible in use, and store them in a dark place. Light tends to harden rubber.

WHEN YOU... Keep them away from steam lines, furnaces and hot objects as much as possible in use, and store them in a cool place. High temperatures shorten the life of rubber.

Even those who are using Hazacord (water, acid and alkali-proof) or Hazaprene (oil and sun-proof) will get still longer service from these unusually durable cords by taking these simple precautions.

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Works: Wilkes-Barre, Pennsylvania
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Insulated Wires & Cables

Industrial Electrification

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RULES

IN these hurried days of plant conversion, 24-hour operation and heavily burdened maintenance staffs, there is a strong temptation to shove aside the often complicated rules that govern safe wiring practice. But never in industrial history have we needed more strict observance of the Code.

Through forty years of development by practical men faced with practical safety problems the Code serves as the accumulated wisdom of our industry devoted to protecting life and property against the hazards inherent in electric power.

No set of rules can supplant able workmanship, sound materials and competent supervision. Code rules are minimum standards. They assure safety when they are intelligently applied by skilled workmen. Wiring installed under competent supervision can sometimes safely deviate from the Code. But such work should be exceptional.

Previous articles covered—

1. Simplifying Electrical Maintenance
2. Preventive Maintenance of Distribution Systems
3. Preventive Maintenance of Electrical Equipment
4. Reducing Power Costs
5. Maintaining Good Power Factor—Part I
6. Maintaining Good Power Factor—Part II
7. Meeting Severe Service Conditions
8. Eliminating Causes of Severe Service Conditions
9. Providing Adequate Capacity for Increased Demand
10. Electrifying Operations to Reduce Unit Costs
11. Safety Protection for Electrical Operations
12. Increasing Flexibility of Electrical Service
13. Electrical Aids to Automatic Control
14. Electrical Ways to Reduce Waste
15. How to Save Power
16. Protection Against Sabotage
17. Improving Working Conditions
18. Electrifying for Continuous Operation
19. Electrified Plant Housekeeping
20. Electrical Problems Under 168 Hour Schedules
21. Electrical Aids to Plant Conversion
22. Electrical Aids to Quality Control
23. Electrical Aids for Green Help
24. Codes in Wartime (this issue)

Future articles will discuss—

25. Welding in Industry
26. Grounding

CODES IN WARTIME

THERE has not been any better electrical safeguard to life, property and production than to keep wiring up to Code standards, and this still holds true during our emergency. The purpose of this article is not to attempt to vindicate the existence of our Factory Codes. Their high value is granted. Instead, the aim is to show how the provisions of the National Electrical Code can generally be satisfied in various ways to provide safety in wiring. The essence of the Code always has been that its provisions constituted the *minimum* standard for safety. That minimum should not be lowered now that production has become vital, because production is based on continuously available power.

Factory Codes mean, primarily, the National Electrical Code insofar as their electrical sections regulate installations. The many standards of the National Fire Protection Association make reference to the National Electrical Code for installation of electrical equipment. To name a few: Standards for the Prevention of Dust Explosions, Paint Spraying and Spray Booths, Installation of Oil Burner Equipment.

Today's demand for speed tempts the unwary into violations of the safety regulations of the Code. It is human to accede to these demands, and to promise to "fix things up properly" as soon as one gets a chance. At this moment a wise man discerns what is essential and that which is only desirable. Sacrifice appearance, but not safety. An old switch may have to be used, but just so long as it is properly fused, then wiring will not be abused. Admittedly, occasional relapses will have to occur, but violations can be avoided or minimized by following a few such fundamental rules.

Wiring systems, installed as per the Code, will always be understandable, and permit of rapid changes at a later date. Haywire, with its jumbled feeders and snarled branches, carries with it too great a chance of service interruption. After all, the Code is not some theoretical masterpiece, but is a working out of electrical service security by practical men for best results under practical conditions.

Service Equipment

Service protective equipment is required for two purposes, to provide (1) overcurrent protection, and (2) means of disconnection.

Overcurrent devices must be adequate to ensure circuit interruption without disturbance. This means that circuit breakers must have sufficient interrupting capacity to meet the duty which might be imposed upon them. The utility company will give this information on IC (interrupting capacity) for each individual service.

Where load is to be considerably increased, the adequacy of service equipment should be checked by the utility. Metering equipment might become overloaded, or service capacity in transformers or conductors might need strengthening. Code makers have wisely provided regulations whereby capacity may readily be added without having to resort to extensive service changes.

More than one service drop may be installed to a building, an additional service may be installed to supply a different class of use, and service equip-

ment may be subdivided into groups of switches or breakers.

These liberal provisions have restricted applications, and under the stress of time and material shortages, Code violations are apt to creep in. For example, an unorderly arrangement of service drops could seriously hamper fire-fighters in their use of ladders. The regulations allowing for the subdivision of service equipment require that the various switches be grouped at the service entrance, and that each such piece of equipment be marked to identify it.

Service equipment must be readily accessible, and quickly reached for operation. It may be outdoors. Of equal importance is the matter of keeping the service area clear of obstructions. Time should always be found to mark the main switch and surrounding boxes. The confusion thus later avoided may save a life.

Service raceways differ from ordinary conduits in that they carry unfused conductors, which may carry abnormally heavy currents on breakdowns. Therefore, service raceways must not be used for other conductors, except grounding and control conductors. To avoid the need for this sort of thing, spare raceways should be installed, in the first place, to any outdoor supply point.

Regarding the number of overcurrent units of service equipment, the requirement that there be one in each ungrounded conductor will, at times, be difficult to comply with. If the service is 3-phase, and all that is available is a breaker having two trip coils, full protection could still be provided by cutting a fuse into the middle conductor.

As for the mechanical arrangement of service equipment, the Code has provided that the service head may in one case be dispensed with. On underground services, when duct and conduit are not available, other forms of protection, such as creosoted trough and plank covering can still be resorted to.

Switches

Ratings of available switches may not match the system, and this ordinarily would mean delay. Today, we must keep machinery turning. Where it happens that the only switch on hand for a 250-volt job is of the 575-volt class, fuse-reducers might be used until such time as a proper switch could be installed. However, this plan will not work in reverse. The danger to life and property of applying a lower-voltage switch to a higher-voltage system is too obvious to need any further words of caution. If the voltage rating is right, but the switch has too great a current rating, again we should use fuse-reducers and thereby provide both initial and subsequent proper protection. Conversely, time-lag fuses will enable one to start a motor using a switch of lower current rating. The Code recognizes their use provided appropriate fuses will be continuously available.

Where open switches have to be used, it should be kept in mind that live parts must be enclosed against accidental contact, and locking means (padlock and hasp) provided for doors giving access to live parts.

Grounding

The connections to ground of wiring systems and electrical equipment are excellent preventives of fires and of shocks with their attendant accidents, yet these measures are easily overlooked because motors will turn and lights burn without these connections.

11 POINTERS

1. Don't let need for speed trap you into needless Code violations.
2. Sacrifice appearance, not safety.
3. Maintain safety measures on all temporary work.
4. Ground everything.
5. Transformer capacity may be the troublesome bottleneck, settle this first.
6. Color-code lighting and branch circuits. Tag or paint if necessary.
7. Don't disregard motor overcurrent protection.
8. Keep controllers within sight of motors and machinery.
9. Use fuse reducers on oversize switches until proper switch can be installed.
10. Badly located service drops hamper fire fighters.
11. THE EMERGENCY DOES NOT EXCUSE CARELESSNESS.

A recent horrible example was that of a temporary 440-volt entrance switch mounted high on a wall and beneath which was the sprinkler entrance. The switch was without grounding connection. To operate it meant that one had to stand on these pipes.

Another example involved a machine shop in an overgrown garage out in the country, where a 120/240-volt lighting system had been derived from the 3-phase power supply. The system was ungrounded. The territory had above normal exposure to lightning. The absence of a circuit ground meant that any high potential imposed on the wiring system would have resulted in insulation breakdowns with possible fire.

To start at the entrance, a useful allowance to keep in mind is that the uninsulated service neutral may be used to ground metering equipment on the supply side of the entrance.

The entrance equipment can, itself, best be grounded on systems having grounded neutrals by the fastening of the grounding conductor directly to the switch case, except on d.c. services. This is especially easy on switches having "groundable" neutral terminals. However, it should be noted that the Code does not permit the use of a conduit alone as a common grounding conductor, a corrosion-resistant material being required.

The Code gives a choice of means of grounding equipment. It may be fastened to the building frame. The grounded circuit conductor may, by special permission, be so employed. Conductors, separate, or in cable assemblies and raceways are standard means. If in a cable, the conductor used for grounding has to be finished to show a green color. A can of green paint should facilitate this identification, which guards against the risk of energizing a framework through the connection of this grounding conductor to a live conductor.

The Code regulation that appliances used in boilers, etc., be grounded or supplied at low-voltage, can be met in the case of the hand-lamp by using an assembly comprising an air-cooled step-down transformer having standard connection cord and cap, plus cord to the low-voltage lamp.

At the other end of the scale, with higher voltages, where shielding tapes safeguard conductor insulation from corona, this tape should be stripped back a safe distance and grounded at the terminals, and thereby the building-up of dangerous potentials prevented.

With the increased use of enamel-coated materials, as on electrical metallic tubing, we must remember that clean surfaces are essential to satisfactory and safe grounding paths.

Responsible electricians surely appreciate the value of grounding. It is the handyman who must be looked out for, the type who hooks up 440-volt portable welders without knowing enough to ground their frames.

Transformers

Oil-filled apparatus is always a hazard of serious possibilities, and while such transformers have caused very little trouble, nevertheless, the danger from oil is always great. As for dry-type transformers, these often have higher surface temperatures than the oil-filled variety, and consequently their ventilation is more important. Where we are concerned with transformers filled with

MAINTENANCE GUIDE SHEET

MEETING THE CODES DURING WARTIME

	POSSIBLE VIOLATIONS	ALTERNATE METHODS	NATIONAL ELECTRICAL CODE
OTHER STANDARDS			Back Cover Page
SERVICES	Breakers of insufficient interrupting capacity on service increase.	Use separate drops.	Section 1114
		Use additional service.	" 2321
		Use groups of service switches (and of supply transformers).	" 2302
	Failure to group and identify multiple service switches.		" 2351
			" 2351
	Equipment inaccessible.	Relocate. Place outdoors.	" 2359
	Use of service conduit as common raceway.		" 2351
			" 2308
	Insufficient trip coils.	Fuses may be employed.	" 2371
SWITCHES	Overfusing for starting current.	Time-lag fuses of proper size.	Section 4347
	Exposure of live parts.	Boxing.	" 2381
GROUNDING	Failure to ground meter equipment.	Use grounded neutral.	Section 2382
	Failure to ground switch case.	Use common ground.	" 2553
	Failure to ground equipment.	Various means available.	" 2556-2559
	Use of ungrounded portables in tanks.	Low-voltage devices.	" 2545
	Failure to clean surfaces.		" 2617
TRANSFORMERS	Placed near combustible material.	Vault.	Section 4503
	Insufficient ventilation.	Place outdoors.	" 4503
	Drainage to building.	Curbing.	" 4507
MOTORS	Lack of thermal protection.	Install separate relays or cutouts.	Section 4322
	Motor not within sight of controller.	Relocate motor within sight of operator.	" 4322
		Use lock on controller.	" 4386
	Failure to ground controller.		Section 4438
	Single disconnect for group.		" 4410
	Insufficient rating.		" 4410
LIGHTING	Lack of identified wire.	Paint at outlets.	Section 2006
	Overfusing of branches.	Type S fuseholder, breaker.	" 2123
	Panelboard fibre cutout failures.	Replace with mica parts.	" 3881
	Unbalancing of loads.		" 2107
	Incorrect switching 230-V. units.	Use double-pole switches.	" 4164
	Overfusing of feeders. –	Fuse at panelboard.	" 3882
GENERAL	Failure to close unused openings.		Section 3718
	Lack of protection for open wiring.	Boxing, running board.	" 3212
	Omission of bushing, or of insulation.	Use substantial insulating material.	" 3468
	Lack of rubber splicing compound.	Cotton or cambric, plus friction tape.	" 3012
	Use of 1937 wire tables on continuous load.	Use 1940 values.	" 3009
			Interim Revision No. 3008

a liquid that will not burn, the possible dangers from toxic gases must be guarded against.

Ordinarily, the best place for a transformer is in a vault, but they may be placed outdoors or within buildings, with reasonable safety, when Code regulations are followed.

Small oil-filled units not over 600-volts, located indoors, must be kept away from combustible material, and larger banks must, in addition, be surrounded by an oil-retaining curb.

Dry-type transformers are generally located indoors, but too often without required ventilation. Care should be taken that such units are not later surrounded by combustibles as, was one 75 kva. bank which had folded cartons stored on top of it.

Non-burning liquid-filled transformers generally come equipped with pressure-relief vents. The additional precautions for taking care of the toxic gases, which can be released on the failure of such transformers, are covered by the Code, and are that gas-absorption devices or ventilation be provided. This type of transformer may be placed near its load without need for a vault. For protection of indoor transformers, common practice is to fuse for short-circuit on the high side, and to take care of overloads by secondary protection. The Code recognizes this plan, but limits the percentage of overfusing permissible on the primary side.

With loads being added rapidly during this emergency, supply transformers soon become overloaded. It is so easy to run another circuit to such a transformer and forget all about the available capacity of the transformer. This temptation should be resisted, especially where air-cooled units with their lower thermal reserve capacity are involved.

Where transformers are placed outdoors, a precaution to be observed is to so arrange drainage as to keep overflowing liquid away from combustible structures or materials. If transformers are to be wall-mounted, they should be kept away from windows, doors and stairways.

Motor Circuits

The most chronic motor complaint in normal and in emergency times is the misapplication or complete lack of motor overcurrent protection. This refers not to the overcurrent devices protecting the motor branch against short circuits, but to the thermals which would save the motor and its branch from injurious overloads.

Motor thermals are supposed to be set at not over 125 per cent of motor rating, yet the Code allows leeway up to 150 per cent, where the values specified do not correspond to standard sizes of thermal relays or cutouts. This leeway helps to live up to Code rules and consequently safety.

On many installations where thermals have been used, these have been left without back-up short-circuit protection. This sort of job shows lack of appreciation of the limitation of thermal cutouts, and it would not occur if the instructions issued with the thermals were followed. The Code specifies that fuses or breakers of not over four times designed motor rating be installed to give short-circuit protection.

Still referring to thermal protection, a fairly common oversight is the failure to use thermal protection for motors 1 hp. and less. True, the Code does exempt this class, but only under specified conditions. Where such a motor is automatically started, or if it is so located as not to be within sight of the operator, then thermals must be used.

When it comes to the placing of controllers, care should be exercised that these are located so that the motor and machinery shall be within sight of the control point. In these times when open wiring must be employed more often as the wiring method, the grounding of controller cases must be kept in mind.

The rule that a single disconnecting means may serve a group of motors is indeed a useful and material-saving regulation, a vital consideration now, but its misapplication can be dangerous if all motors are not within sight of this single disconnect. A recent bad example was in a woodworking shop with about a dozen motors where the disconnect was in a separate room, completely out of sight. The awfulness was augmented by the fact that knife switches were the only controls used on this dangerous machinery.

Motor branches are generally made to match 125 per cent of motor rating so far as current capacity goes, but the length of such a tap is sometimes a violation. The Code allows us to run up to 25 ft. to an accessible location for the branch cutout, but only if the branch is at least one-third feeder capacity.

The branch fuseholder capacity must be sufficient to take a fuse big enough to handle the starting current, even though the initial load might be so light that a smaller cutout would be sufficient. This requirement overcomes the subsequent cutout overfusing, which becomes necessary when the load grows. The allowance of the use of time-lag fuses does allow for the installation of a smaller cutout. The same allowance would apply to fusible switches, but here care must be taken to be sure that switches of sufficient hp. rating are selected for each job.

A situation now confronting us is the lack of suitably colored wires for identification, a valuable safety regulation. Recently, a contractor running house services had to use two white wires with a bare neutral, because black wire was not obtainable. Nevertheless, he avoided a Code violation by the application of black paint at the outlets.

Overloading

A major trouble always with us in slack times, or busy spells, is the overfusing of lighting branches. It is so simple to plug in a larger fuse. The tamper-resistant type S fuseholder had an untimely start a month before war broke out. Time-lag devices are suggested where the starting of motors blow ordinary fuses. Where maintenance cannot be closely followed, the breaker seems to be an excellent device to prevent tampering and overfusing by the incompetent.

Heavy loads of long duration ultimately destroy fibre parts of plug fuseholders, and this is a pernicious trouble, which never reveals its presence because the shorted cutout passes current even with the fuse removed. Routine inspection is required to detect this hazardous condition. This unintentional violation develops where many heavy circuits are closely grouped on a panelboard.

The unbalancing of lighting loads is especially likely to take place where circuits are being frequently extended. This is a trouble easily detected with a clip-on ammeter. Failure to detect this condition results in frequent fuse operations on the feeder supplying the lighting transformers or panels.

Color-coding of branch circuits is an aid to maintenance of a balanced system. During these days of scarcity, the regular colors of wires may not be available. Tagging or painting will serve the purpose. Use any consistent colors, with gray for the neutral.

Fluorescent units rated 220-volts save copper, and where supplied directly from the power circuits, also avoid transformer investment and losses. Care must be taken for safety's sake that correct switching is employed. Grounding is doubly important in such cases, yet frequently we see the grounding conductors of cords from fixtures left unconnected at the outlets.

A Code panelboard regulation, sometimes forgotten about, is one calling for not over 200-ampere over-current protection of the panelboard feeder. This prevention against destructive short circuits is an easy one to overlook during emergency days.

The simplest little violations can cause accidents. A flash recently occurred, when cooling fluid was blown

[Continued on page 122]

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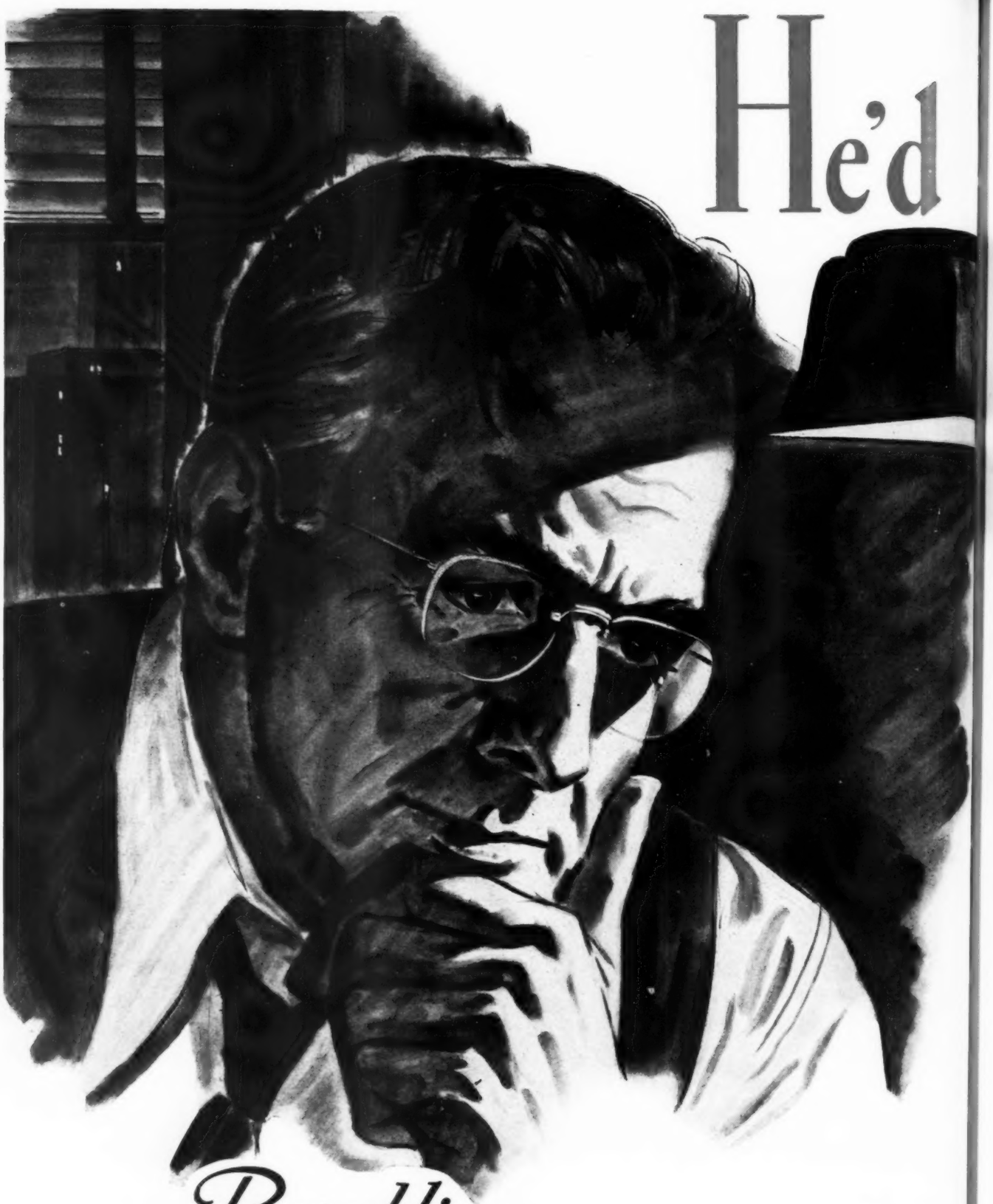

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FASTENING and HANGING DEVICES

in through an unused knockout of a control switch on a milling machine by an inexperienced operator using compressed air.

Open wiring is meeting the demand for a system using a minimum of metal. Care must be taken that this system is not installed without mechanical protection in exposed locations, such as on walls and posts. Wood boxing and running board will prevent wiring damage to these conductors. Grounding of equipment will call for special attention where this system is employed.

Conductors are most subject to damage at terminals and outlets. In haste, conductors are oftimes stuffed through unprotected knockouts, or if conduit bushings are used, the wires may be sharply bent around the bushings. The Code calls for substantial insulating material to be installed where large conductors are deflected entering a box.

The covering of conductor splices will call for new ideas now that rubber tape is not on hand. The problem will be to so cover a joint that it may be flexed without opening of the insulating covering. Seemingly, if we use sufficient cotton or cambric tape, covered by friction tape, and handle the splice with due care, we should be able to make up trouble-free work.

There is an appalling disregard of common-sense safety measures with much of our temporary work. Open panels without guards; outdoor wiring strung in any old way, low enough sometimes for persons to walk into; the use of the largest-sized fuse the temporary cutout will take, with no regard to circuit capacity; services strung along building walls within 5 ft. of the ground, and where construction workers are busy; lack of grounding of motor-driven machinery; failure to remove plugs from vent pipes of oil circuit breakers; no one paying attention to the need for barriers around open high-voltage equipment, even though masonry workers were engaged nearby; neglect to tighten terminals, and so on. The emergency does not excuse such carelessness. Instead, it demands that we be ever conscious of the hindrance to production of such sloppy methods. It does not take any appreciable extra time to nail that board over the open switch, or to thoroughly tighten that connection. The emergency requires that we be even more on the alert and cut out the carelessness.

An insurance man once said that they never hand any temporary fires. Observance of a few simple rules will go far to keep production rolling. Use the right size of fuse—that is our safety link. Keep temporary wiring up out of reach. Ground equipment. Temporary work is part of our business, but we should avoid letting it take the place of safer permanent wiring.

Regulating Generator Helps Load Furnaces

A small motor-generator regulator circuit connected in a Wheatstone bridge circuit with exciter field of a variable voltage generator to obtain control of a d.c. motor has been used as a means of stopping of elevators at floor levels regardless of the number of passengers. Now it has found a use to control a skip that feeds raw materials to a blast furnace. Other uses include machine tools, hoists, electric shovels, etc.

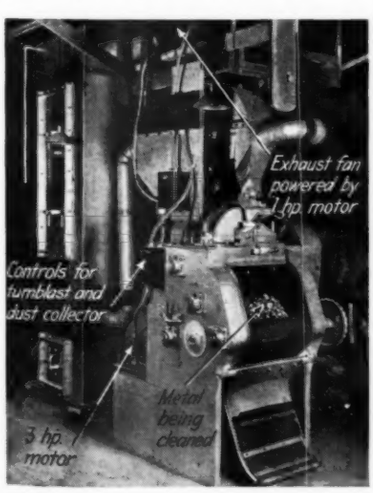
The blast-furnace hoists hauls a variety of materials of greatly differing loads up the almost vertical incline to the top of the furnace. On one trip it may be limestone or coke, far lighter than the ore hauled up the next trip. If the skip rising swiftly to the top does not always stop accurately at the same unloading level, it may either jam or cause poor distribution of materials in the furnace. With the regulating-generator scheme the skip slows down to the same stopping speed whether it is hauling a heavy load of ore or even running overhauling with a light load of coke.

Better Metal Cleaning

The Algonac Foundry Company, Algonac, Mich., was experiencing many difficulties in getting proper cleaning action on brass parts.

As a solution to the problem a Wheelabrator Tumblast machine was installed for the cleaning of brass and bronze bushings and miscellaneous boat hardware.

Now a typical load is cleaned in five or six minutes with a fine steel grit. This time represents a considerable saving over previous methods used.



AIRLESS abrasive blasting mill cleans and finishes the small work in loads up to one cubic foot.

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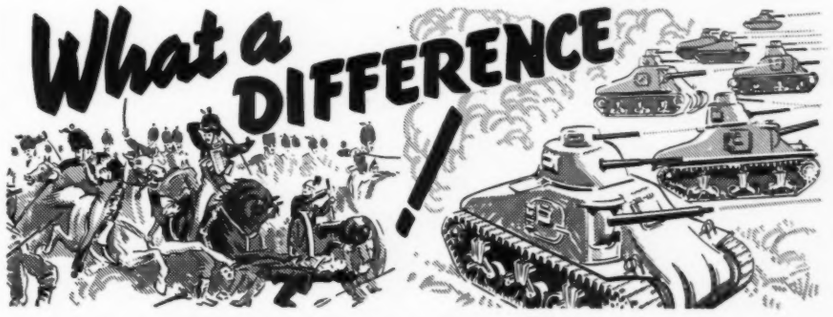
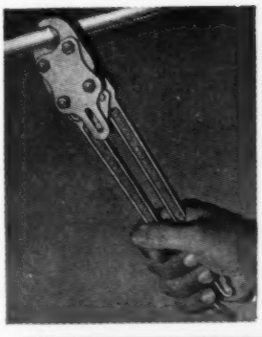


And there is just as much difference between the *streamlined* BRIEGEL METHOD of making conduit connections and old-fashioned methods.

The BRIEGEL METHOD saves you up to 50% on time and a substantial saving on materials allowing you a larger margin of profit on each job. Make quick, easy, strong and neat connections this MODERN way.



No extra turns or twists, no nuts to tighten when you use B - M connectors and couplings. Just TWO SQUEEZES with the patented B-M indenter (which costs you only $1.25) and you have a smooth efficient job. Approved by Underwriters Laboratories.

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Reader's QUIZ

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

PHASE ROTATION CHECK

QUESTION 55. Our portable conveyors, driven by 2- and 3-hp., 3-phase motors can be plugged into any one of 10 receptacles connected in four circuits from two distribution panels. Receptacles are non-reversible and motor terminals must be changed to obtain correct speed rotation when some receptacle connections are made. How can the same direction of rotation be obtained for all plug-in connections?—R.M.S.

A. TO QUESTION 55. The desired direction of rotation may be obtained by making connections such that the phase rotation at each outlet will be the same as that of all others. Either ABC or ACB.

Start at the distribution panels and see that the phase rotation supplied to the branches is the same on all circuits. Every receptacle can then be tested, with a phase indicator or a motor. If the phase rotation is found to be reversed simply switch any two leads in the receptacle. As receptacles are non-reversible, some of the motor leads may have to be changed at the plugs in order to make the motors rotate in the right direction.——R.L.M.

A. TO QUESTION 55. Where 3-phase motors are to be connected by means of portable cords and plugs and receptacles, the wiring to the receptacles should be checked so that corresponding contacts in the receptacles will be connected to the same poles of the circuit. That is, connect contact A to the A phase in each case, contact B to the B phase and contact C to the C phase.

Check the plug on one motor and change connections till the rotation is correct. Then connect the plugs in the other motors in the same way. In this way all connections will be made in the same way and the direction of rotation should be the same in all cases.

If these motors are operating at 230 volts, so that the voltage to ground is over 150 volts, the motor frames should be grounded. This may be done by means of a fourth conductor in the cord. This should be connected to the motor frame and through the raceway system to the service entrance ground.—J.E.W.

A. TO QUESTION 55. Test each of the 10 receptacles for phase rotation. When each are the same, any motor will run the same direction when plugged in any one of them. To make a phase rotation indicator, use two lamps of equal size and a high inductive reactance connected in Y. These are connected to the three line wires of a three-phase system, as shown in Fig. 1. When this connection is made it will be found

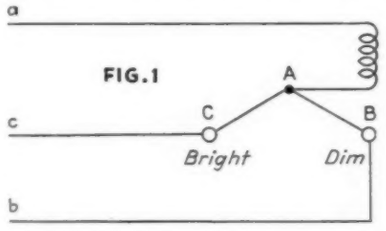
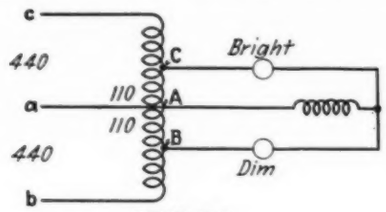


FIG. 1

that one lamp is appreciably brighter than the other. The sequence is then reactance lead, dim lead, and bright lead.

If your supply is three-phase, 440-volts, use the method in Fig. 2. This test method can be arranged in a permanent test and the three leads a-b-c connected in any order on a plug that fits your receptacles. Plug into one of the receptacles that gives proper rotation to your motors. Note which of the two lights is brightest. Then continue on to the other 9 receptacles and note which is brightest. If not the same one as in the first case, reverse two of the wires connected to that receptacle.

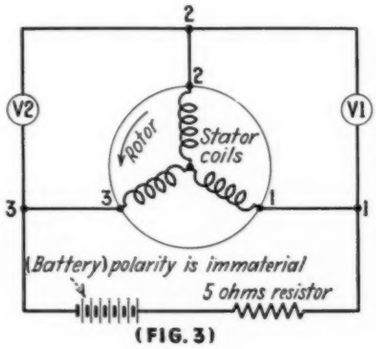
To check the phase rotation of the motors without connecting to the line,



(FIG. 2)

use a storage battery, a five-ohm resistor to limit the current and two low reading direct current voltmeters. Connect them together as in Fig. 3.

The numbers represent the three motor leads. The No. 2 lead is always the one that connects to both of the voltmeters.



(FIG. 3)

The numbers of the other leads are determined by which way you turn the rotor by hand and noting which voltmeter denotes a decrease in voltage and which an increase. No. 2 lead is the one which connects to the former voltmeter and to one terminal of the battery. No. 3 lead is the one which connects to the latter voltmeter and to the other battery terminal. This now indicates, that for the direction of rotation in which the rotor was turned during the test, the phase-rotation of the stator leads in 1-2-3.

Referring again to the diagram, let us assume that during the test the rotor was turned counter-clockwise as shown by the arrow and leads marked as shown, then voltmeter V1 will show a decrease in voltage and V2 an increase. Therefore, for the rotor to move counter-clockwise, the rotation of the stator leads is 1-2-3.

If these leads 1-2-3 are connected respectively to receptacle leads a-b-c the motor will run counter-clockwise. Reverse any two leads and it will go clockwise.—O.R.F.

COMMUTATOR FLAT SPOTS

QUESTION 56. On a direct current generator the brushes are arcing very badly, causing the commutating surface to become flat. These bars where the flat spots show are burned. This generator apparently has been rewound as the specifications do not agree with the manufacturer. The present nameplate data is Type RC-29, compound wound, 125 volts, kw. 10, rpm. 1150, amperes 80. The original should have read Type RC-29, shunt wound, 115 volts, 78.5 amperes, 4 pole. What is the remedy?—D.J.F.

A. TO QUESTION 56. Apparently, the current rating of this generator has been increased only 1.5 amperes but the terminal voltage has risen 10 volts above the initial rating. The net result is an increased output of about 11 per cent. In changing it from a shunt to a cumulative compound, other factors have been altered, and in consequence of this the characteristics of the machine have also changed perceptibly. The additional variable losses have very possibly increased 100 per cent. These include the armature, shunt field and series I^2R (it is assumed there is no interpole field). However, in view of the increased output the operating efficiency may still be equal or less than its former value.

In compensating for the additional losses, the actual generated voltage of the armature has been altered proportionately with a corresponding inductance effect due primarily to the field flux increment. The net summation of these changes bear directly on the operating position of the neutral plane. With an increased load on a generator (other things remaining equal) the neutral plane shifts toward the direction of rotation, but in this case, due to the relationship of series field flux with armature current, the net armature reaction effect may actually be less than the initial value when operating as a shunt generator. Consequently, assuming that the brushes are still in the original position, a backward shift of two or three bars should eliminate arcing.—O.A.

A. TO QUESTION 56. First check the spacing of the brushes, next be sure that they are the proper width, then check the leads from commutator to the iron and back to the commutator, so you will be able to locate the neutral plane. After the generator is up to speed and the full load is on the brushes they will have to be shifted to the commutating plane, which will be in the direction

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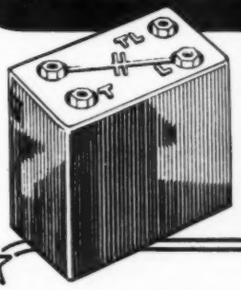
MALLORY CAPACITORS



Withstand the Punishment of Constant War Production Service

When you replace capacitors on any electric motor, you will do well to standardize on *Genuine* Mallory Capacitors. They are built to "take it" —to last longer and give better service.

Remember, too, you can make more replacements with a smaller stock with Mallory Universal AC Capacitors; yet the line is complete. It meets all requirements for both round and square types.

Get in touch with one of the offices listed here or write for the IWI Blue Catalog.

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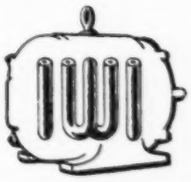

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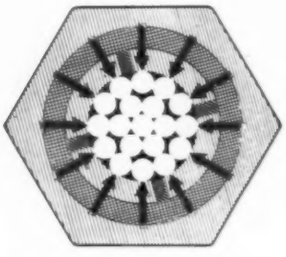
"Gorilla Grips" make perfect contact!



The cross-section shown above illustrates how the conductors are compacted and gripped around the complete outside surface by the "Gorilla Grip" Connector. Loose contacts or distorted conductors set up high resistances and are often the real cause of motor failure. National Electric "Gorilla Grip" Connectors are designed to compact the cable and permanently hold, insuring a perfect electrical connection.

Write for a catalog.

Three Way Connector

National Electric
PRODUCTS CORPORATION
1000 FULTON BUILDING PITTSBURGH, PA.

Reader's QUIZ

[FROM PAGE 125]

of rotation, it may be ½ a bar to 1½ bars, depending on the load.

I have experienced this same condition and this procedure will cure the trouble, assuming that you have the proper size brushes to carry the current. —R.W.B.

A. TO QUESTION 56. The following may be the cause of your trouble. If it developed recently after running satisfactorily previous to this, the trouble may be due to wear. If the commutator is not undercut the copper may be worn down below the mica. This causes the brushes to jump and arc as they pass over the mica and the copper bars burn, usually at the leading side of the bars. If this is the case the commutator should be trued up and new brushes installed. The brushes should be just abrasive enough to be able to wear the mica down with the copper. If the commutator is undercut the slots may be partially filled with dirt and carbon. This will shoot the bars and usually causes a ring of fire around the commutator. It causes heating and brush arcing.—C.E.S.

Can You ANSWER these QUESTIONS?

QUESTION K2.—What kind of tool is used for stripping the steel basket weave covering on cable used for marine wiring and where can they be obtained?—J.J.L.

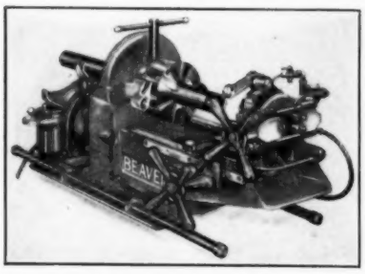
QUESTION L2.—I have 25 timers operating 25 14-volt coils on 25 ampere contactors. The contactors open and close 125-volt solenoids, the solenoids draw approximately 19 amperes. The 25 ampere double pole contactors operate approximately eight times per minute, 16 hours per day, five days a week. The contact points have to be renewed approximately every 60 days.

Do you think the contact points would last longer if they were immersed in oil? Or would you suggest something else that would give me better service?—R.E.P.

QUESTION M2.—On one of our d.c. motors which has four sets of brushes on the commutator, two sets of the brushes wear away faster than the other two. Using different kinds of brushes and careful adjustment does not change this relative wear. What would cause this uneven wear, when all of the brushes are of the same make and grade?—R.C.M.

PLEASE SEND IN YOUR ANSWERS BY AUGUST 1

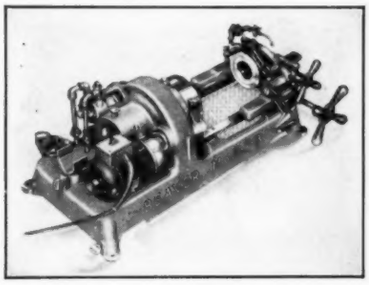
The A-B-C of . . . **Pipe and Bolt Machines!**



Beaver Model-A

A high-speed heavy-duty deluxe Pipe and Bolt Machine. Range ⅛ to 2-inch-up to 12-inch with geared tools and drive shaft. Bolts, ¼ to 2-inch. Wt. 415 lbs.

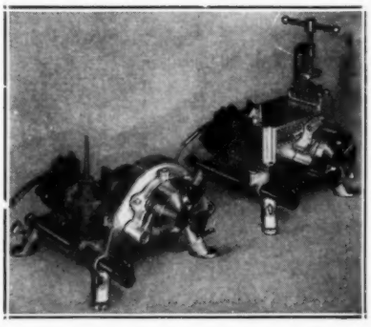
Write for Bulletin A



Beaver Model-B

A light-weight utility Pipe and Bolt Machine combining many features of Model-A with the easy portability of Model-C. Range ⅛ to 2-inch up to 8-inch with drive shaft and geared tools. Bolts up to 1½-inch. Weight 280 lbs.

Write for Bulletin B



Models C-1 and C-2

A STURDY LITTLE POWER UNIT Converts hand pipe tools into power tools from ¼ to 8-inch. Threads 8-inch in 6 minutes. Threads bolts up to 1½-inch. Two men can work at the same time without interference. Weight 150 lbs.

Write for Bulletin C

Write for new Tool and Machine Catalogue—Just off the press

BEAVER PIPE TOOLS

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For MOTORIZED PRODUCTION LINES

Allen-Bradley Bulletin 712-713 combination starters require little space in crowded production lines.

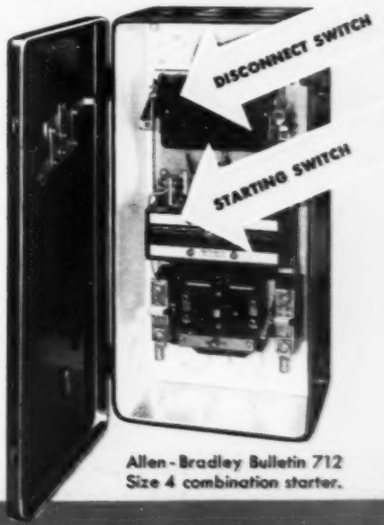
use COMBINATION STARTERS

SAVE SPACE—These combination starters take less room than two units. With disconnect lever in front cover, Bulletin 712-713 combination starters may be grouped close together.

SAVE WIRING—Bulletin 712-713 combination starters are quicker and easier to install than two separate units. Take less material to reconnect when machines are moved.

SAVE TIME—On new machines or in the shifting of production lines, Allen-Bradley Bulletin 712-713 combination starters are great time savers. Only one unit to mount . . . only one unit to connect.

ADD SAFETY—Cabinets cannot be opened unless disconnect lever is in OFF position. No live parts are exposed to machine operators. Send for Bulletin 712-713.

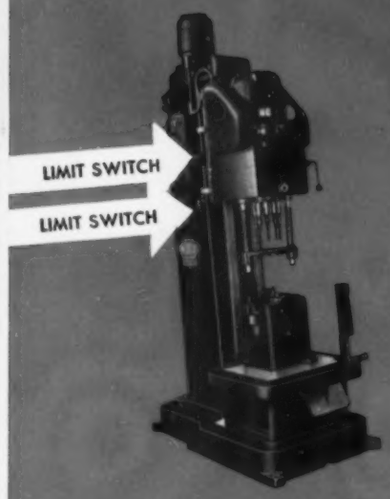


Allen-Bradley Bulletin 712 Size 4 combination starter.

ALLEN-BRADLEY

BULLETIN 712-713 COMBINATION STARTERS

QUALITY



Bradford Drilling and Tapping Machine with A-B Limit Switches.

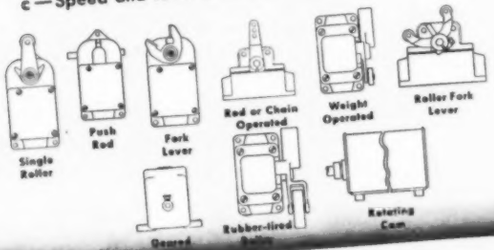
Baker No. 1 Key Seater with A-B Precision Limit Switches.

A QUICK and EASY WAY to solve your LIMIT SWITCH problems

Select standard Allen-Bradley controls to fit any special limit switch requirement

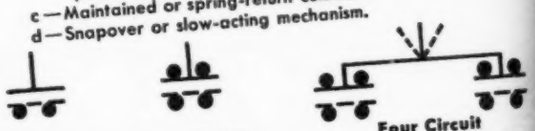
1st— Determine the type of mechanical motion

a—Straight-line, curved, or rotary.
b—Length of travel and overtravel.
c—Speed and force of movement.



2nd— Take advantage of wide variety of contact arrangements

a—Number of circuits.
b—Interrelation of circuits (normally open or normally closed).
c—Maintained or spring-return contacts.
d—Snapover or slow-acting mechanism.



A-B limit switches are available in a wide variety of normally closed contacts; extra relays can often be avoided.

3rd— Distinguish between standard or heavy duty service

a—Frequency of operation.
b—Severity of service.
c—Atmospheric conditions.
d—Keep pilot current within limit switch rating.

Examples of Allen-Bradley standard and heavy duty limit switches.

4th— Be sure to use the correct enclosure

a—Determine nature of application.
b—Select enclosure of correct Nema classification.

Write for Bulletin 801

Allen-Bradley Company, 1321 S. First St., Milwaukee, Wis.

ALLEN-BRADLEY

BULLETIN 801-2 LIMIT SWITCHES

QUALITY

Estimating

ESTIMATING GUIDES

—Power Branch Wiring

The branch wiring for power circuits is the subject for consideration in this the fifth installment of the "Estimating Guides" series compiled by the Electrical Contractors Association of the City of Chicago.

Again we reiterate the importance of developing a system of take-off and pricing that leaves no room for errors. This systematic approach to estimating should be followed through to the very last item of material and labor on the branch circuit.

One point that is frequently overlooked in power branch circuit wiring is that of disconnect switches and motor control equipment. It is important to carefully check the plans and specifications to determine how much of this equipment the contractor must furnish. Frequently, magnetic controls are furnished and mounted on machines by the machinery manufacturer. It is also important to check the N.E. Code to find out what type of disconnect, if any, is necessary. Often these points are broadly covered in specifications by the statement "according to the National Electrical Code".

What does power branch circuit wiring cover? It covers everything from the power distribution panel, or distribution bus duct, as the case may be, down to the very last control button on a motor or piece of apparatus. For the average job the material on the take-off sheet should include:

1. Conduit.
2. Wire or cable.
3. Switches, starters and controls (including remote control stations).
4. Setting and connecting motors.
5. Fabrication and installation of frames and supports for free standing equipment. (Often wall mounted equipment requires some sort of framework).
6. Motor pads.
7. Anchor bolts.
8. Miscellaneous fittings and motor connecting materials.
9. Fuses for switches (proper size and type).

RE-CHECK LIST—In all cases the pricing sheet should be re-checked for accuracy in listing:

1. Equipment.
2. Types of motors and starting equipment.
3. Explosion-proof equipment (if required).
4. Average run of conduit and wire per motor.
5. Types and sizes of fuses.
6. Pricing, extension and decimal points.
7. Cost per horsepower. This figure can be compared with similar completed jobs, or be used as a check for future estimates.
8. Re-read plans and specifications to see that you have figured on furnishing all equipment specifically stated or intimated.

Large and more complicated jobs may contain many more items on the take-off list than are outlined above. However, regardless of the size or complexity of a power branch circuit system, the important point is to be sure every item and detail have been covered. Re-check the plans as you check the takeoff and price list.

***INDUSTRIAL BLACKOUT** methods are discussed by Charles H. Howard, (left) Detroit and L. J. Wreggit, Highland Park, Mich., at the recent Wolverine State Electrical Contractors Convention. Mr. Wreggit is president of the Thomas Edison Club of Detroit.*

PLANT CONVERSION ELECTRICAL COST

Plant conversion from non-essential civilian manufacturing to war production is becoming more dominant as industry expands to reach the production goal set by our Victory program. Time and the scarcity of essential materials dictate the reclamation of existing buildings for these new manufacturing enterprises.

In many cases the original electrical system of the building is inadequate or not applicable to the new layout. Then the old system is removed and an entirely new layout designed and installed.

An interesting cost study and breakdown of the electrical work for a typical war plant layout for medium manufacturing purposes was made by an eastern electrical contractor. The following data presents a comprehensive picture of the work done and costs are reduced to unit costs per kw., per hp.; per motor; or per square foot of plant area.

Job Conditions

The converted building was of brick construction with steel roof trusses and a wood planking roof. It was originally an ice manufacturing plant for a brewery and contained electrical equipment typical for that type of work.

The 260-ft. by 100-ft. building provided 26,000 sq. ft. of work area which, under the conversion layout, was divided as follows: manufacturing and motor driven machines, 11,000 sq. ft.; assembly and light machining, 11,000 sq. ft.; auxiliary, storage and office areas, 4,000 sq. ft.

The old electrical system was entirely disregarded and a new and larger power system of busways and fluorescent lighting system were installed.

Electrical Requirements

The power requirements for the converted plant totaled 400 hp. for 100 machines. The lighting load was 50 kw.

Lighting intensities in the various departments were as follows:

Assembly	60–100 f.c.
Machine Shop.....	45– 50 f.c.
Auxiliary areas.....	20– 30 f.c.

Equipment Installed

Three-phase, 4-wire, bus duct comprises the main power distribution system. Plug-in units serve each motor. The lighting consists of a continuous row fluorescent system fed from the bus duct and suspended by messenger cable at 12-ft. centers and 18-ft. from the floor. Three 100-kva., single phase

GET EXTRA MAN POWER WITH GREENLEE BENDERS

EASIER AND FASTER

ONLY ONE MAN TO OPERATE

LIGHT, PORTABLE EASY TO SET UP

POWER TO BEND 1¼"-4½" PIPE

SAVE COST OF MANUFACTURED BENDS

As good man power becomes scarcer in the present emergency, increase the efficiency of your men by turning to a better use of tools. Let Greenlee Benders help you speed up construction by making the work easier and faster for the man on the job. Greenlee Benders are daily saving contractors on defense jobs from 15 to 75% in time and labor costs.

THERE'S A GREENLEE BENDER FOR EVERY JOB

Whatever you have to bend . . . tubing, conduit, pipe, or bus-bars . . . there is a Greenlee Bender to do the job easier and faster. Small hand benders will bend copper tubing from ⅜ to 1⅛ inches and steel, copper, brass, and aluminum tubing from ¼ to ¾ inches. Powerful Greenlee Hydraulic Benders are available for bending 1¼ to 2-inch thin-wall conduit, 1¼ to 4½-inch rigid conduit and pipe, and for bus-bar up to 4 inches wide and ¾ inches thick.

These benders are all readily portable, easy for one man to operate, make smooth, even bends without distortion, and eliminate the need for many costly fittings and manufactured bends. Find out how Greenlee Benders can save vital hours on your defense jobs . . . write for Bender Booklet S-116.

SEND FOR FREE COPY OF BENDER BOOKLET S-116

Greenlee TOOL CO.

1747 COLUMBIA AVE., ROCKFORD, ILLINOIS

Estimating

[FROM PAGE 129]

2400/120/208-volt transformers with necessary switch equipment in an outdoor semi-vault, serve the building. The actual equipment installed included:

3—100 kva., 2400/120/208-volt transformers
220-ft.—750 A., 3-phase, 4-wire bus duct
100-ft.—500 A., 3-phase, 4-wire bus duct
100-ft., 250 A., 3-phase, 4-wire bus duct
130—3-lamp, 4-ft. fluorescent troughs
618—2-lamp, 4-ft. fluorescent troughs
Miscellaneous wiring and equipment.

Cost Data

The installation cost breakdown, including material and labor, for the various components of the electrical system is given below.

SERVICE—includes the installation and connection of three 100 kva., single phase, 2400/120/208-volt transformers, primary and secondary cable and bus rack, main switch and meter panel and necessary connections to the distribution bus duct.

Total Cost	$1,500.00
Avg. cost per kw	4.28

BUS DUCT—includes the installation of 420-ft. of bus duct ranging in size from 250 amp. to 750 ampere. Duct was run down center of the building with branches to feed machine concentrations and various departments.

Total Cost	$6,000.00
Avg. cost per kw	17.12

LIGHTING CIRCUIT WIRING—includes the necessary wiring between the bus duct, lighting panels and the lighting fixtures.

Total Cost	$1,000.00
Avg. cost per kw	20.00

FIXTURES AND LAMPS—includes the installation and lamping of 130, 3-lamp, 4-ft. fluorescent units and 618, 2-lamp, 4-ft. fixtures. Units are mounted in rows on continuous channel fastened direct to supporting messenger cables. Rows are on 12-ft. centers. Mounting height is 18 feet.

Total Cost	$10,000.00
Avg. cost per kw	200.00
Avg. cost per watt	0.20

MACHINE WIRING—includes all the necessary wiring from the bus duct to each of the 100 machines in the plant.

Total Cost	$3,000.00
Avg. cost per motor	30.00
Avg. cost per hp	7.50

MISCELLANEOUS WIRING—includes all the wiring odds and ends that accompany any power and lighting installation.

Total Cost	$500.00

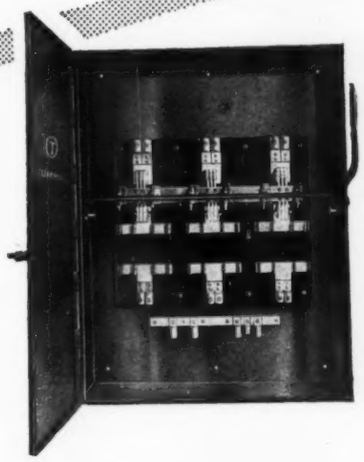
The Complete Installation

An interesting phase of the cost of this typical conversion electrical installation

MAKE SURE YOUR PLANT IS AWAKE at the SWITCH!

STYLE "A"

30 to 2400 Amps., 230-575 V. AC; 250-600 V. DC, 2, 3, 4 pole, single throw, fusible and no fuse. Double throw, 30 to 600 amp. capacities. H.P. ratings 30 to 400 amp.



THESE three types of Trumbull Heavy Duty Industrial Switches are built to stand the grind of three-shift industrial service and for use as motor circuit disconnects. All three perform the same heavy duty functions but differ in design to meet engineering preferences.

STYLE "A"... Features ALL parts OBSERVABLE and REMOVABLE from the front.

STYLE "RBA"... Equipped with FRONT-SIDE handle, permitting close ganging. Receding contacts quench arc in special chamber. Entire switch mechanism mounted on removable saddle.

TYPE "C"... Designed for use where there is less frequent operation and less likelihood of continuous heavy load.

All are quick-make, quick-break, with horsepower rating. All except Type "C" have interlocking covers.

Further illustrated and described in Trumbullaid Bulletin 402.

STYLE "RBA"

30 to 600 amps., 230-575 V. AC; 250-600 V. DC, 2, 3, 4 pole, single throw, fusible and no fuse. H. P. ratings same as Style "A."

TYPE "C"

30 to 600 amps., 230-575 V. AC; 250 V. DC, 2, 3, 4 pole fusible and no fuse, single throw. H. P. ratings same as Style "A."

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY
PLAINVILLE, CONN.

THE TRUMBULL ELEC. MFG. CO. — PLAINVILLE CONN. U.S.A.

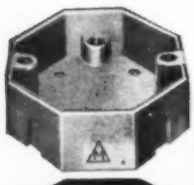
OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES — TRENTON, N. J. (PORCELAIN)

Save Vital METALS···

ILLINOIS

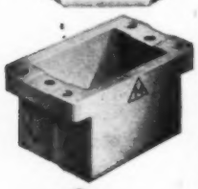
ALL PORCELAIN WIRING SYSTEMS

are safe, permanent and easy to install



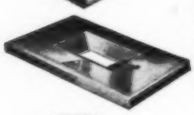
OUTLET BOXES

Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.



SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of best quality white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plugs, outlets, etc. Knockouts for single wires, also for cables. Specify and use them.



STANDARD TUBES

In sizes ⅛ to 48 inches, 5/16- to 3-inch diameter in following types: unglazed, glazed, split, floor, split-floor, headless, curved end, crossover split, and crossover. Diameters all uniform both inside and outside.

KNOBS

Cement coated—nail—genuine leather-washer — code standard. They don't chip when driven in and they stay in place.

Trade Mark Bull Dog Reg. U.S. Pat. Off.

Look for this Trade Mark

• ILLINOIS All Porcelain Wiring Systems are finding wider acceptance today than ever before for residential, commercial, and industrial wiring. The reason is they fit so well into the Victory program by conserving metals, simplifying installation, and insuring permanency. They are particularly dependable where dampness and fire hazards prevail—they don't rust or corrode. You can guarantee ILLINOIS All Porcelain Wiring Systems for longest service life.

TOGGLE SWITCH PLATE

All porcelain with beveled edge and decorative pattern on face.

CLEATS

Standard one, two, and three-wire types.

ILLINOIS ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS

Estimating

[FROM PAGE 130]

is the balance between the total cost of the light and power systems and the relationship between the total material cost and the labor cost. The breakdown follows this pattern:

TOTAL COST—of the complete installation, broken down into material and labor divisions:

Material cost	$17,000.00
Labor cost (2200 m.h.)	5,000.00
Total cost	$22,000.00
Avg. cost (power and light) per sq. ft. of area	$0.85
Avg. labor cost per sq. ft. of area	0.192
Avg. man-hours per sq. ft. of area	0.0845 m.h.

POWER COST—representing that portion of the total cost applying to the power system:

Material and Labor	$10,000.00
Avg. power cost per hp.	25.00
Avg. power cost per sq. ft.	0.39

LIGHTING COST—represents that portion of the total cost applied to the lighting system:

Material and Labor	$12,000.00
Avg. lighting cost per kw	24.00
Avg. lighting cost per watt	0.24
Avg. lighting cost per sq. ft.	0.46

Salvable Material

Another very interesting phase of this electrical cost study is the actual amount of equipment and material installed that is salvable if, for any reason, the company decides to move. The following is the list and cost it represents:

Main Switch	$ 800.00
Bus Duct	4,000.00
Bus Plugs	1,000.00
Panels	400.00
Fixtures	7,300.00
Total Salvable Material	$13,500.00

This investment in material that can be salvaged represents 61.3 per cent of the total cost of the entire electrical installation and 79.4 per cent of the total material cost on the job.

The above cost study presents an enlightening picture of the amount of electrical equipment that goes into a typical medium sized war conversion plant. A glance at the list and dollar value of the salvable material shows what good engineering and the use of the latest equipment and wiring methods will do to preserve the capital investment made in the electrical system. This is in addition to the flexibility advantages provided by such systems.

Data from E. J. White Company, Newark, N. J.

SHUR-LAG

ONE OF THE

LINE

If you want a fuse as good as a Shur-Lag fuse, it can only be another Shur-Lag fuse. This is assured by its exclusive patented features, as well as by the fifty years that the Chase-Shawmut Company has devoted solely to the design and manufacture of electrical protective devices. Made for protection, not for price, Shawmut Shur-Lag renewable fuses and links offer the highest value in both. You can easily prove this for yourself by a comparison in workmanship and performance. Ask your dealer about Shur-Lag Renewable fuses, or write for our Bulletin 400.

The Chase-Shawmut Company
Newburyport, Massachusetts
Fuse Makers Since 1893

Questions ON THE Code

Answered by
F. N. M. SQUIRES
Chief Inspector New York Board of Fire Underwriters

War Emergency Amendment

Q. *"Have been advised that an interim amendment to the Code permitting the use of slow-burning weatherproof and weatherproof conductors for a grounded neutral of a.c. systems has been approved by the Code Committee for the duration of the present emergency. Would be pleased to receive your confirmation or comments."*
—*M.A.*

A. On April 9th, 1942, the following Interim Amendment No. 44 to the National Electrical Code was approved as a war emergency item to be effective only for the duration:—

"To assist in conserving rubber and for the duration of the emergency, on alternating-current systems slow-burning, weatherproof conductors (Type SBW) and weatherproof conductors (Type WP) may be used as the grounded neutral conductor in any of the wiring methods, Articles 320 to 364 incl., of this chapter provided the circuit does not operate at more than 208 volts to ground."

Show Window Lighting

Q. *"A new store has twenty linear feet of show-window. Figuring 200 watts per foot, in determining number of branch circuits for show-window lighting, we get 4,000 watts, which would be 34.8 amperes at 115 volts; 34.8 amperes would require three 15-ampere two-wire circuits which would carry 12 amperes apiece, giving a capacity for lights of 36 amperes.*

"Provision is made in the service equipment to include three 15-ampere circuits for this show-window lighting.

"The question is, providing the capacity is there, (in the disconnect switch and fuse panel) is the electrician required by the Code to run three 15-ampere circuits to the show window? If the owner of the new store wants only three fluorescent fixtures installed for show-window lighting (which can safely be carried on one 15-ampere circuit) must the electrician still install three 15-ampere circuits to the show-window?"
—*W. E. M.*

A. This subject has been widely discussed and might reasonably be debated because of its many varying conditions which might pertain to a general case. Let's think of a few. In the first place, an answer during wartime with metal precious as it is might not be expected to hold under peacetime. Secondly, is the window on Broadway, or out in the country where the full 200-watt load would never likely be used? In the third place, the rule was conceived as an incandescent load before the general advent of fluorescent lighting.

Any such adequacy provision must be understood to be appreciated. Its intent was to do away with the hazards of extensions which might be introduced if an insufficient number of circuits were to be installed at the outset. This wiring condition could very well result in the over-fusing of the original few circuits, plus the evils of cord wiring. Keep in mind also that some windows are filled with combustible materials.

A good solution to just this problem has been offered whereby one would require a raceway from the panel up to the window ceiling, this raceway to be of sufficient size to allow for the installation, at a later date, of the full number of circuits.

These factors may help the authority enforcing the Code to decide if the provision in the panelboard of the correct number of cut-outs constitutes a reasonable compliance of Code regulations, or whether the raceway should also be installed. Of course, there will be cases where, say because of unusual construction, the only reasonable compliance would be to have all circuits installed completely into the window.

Incidentally, Section 2107 requires that an allowance of 125 percent be provided for the show window circuits. That is; the 80 percent factor would apply to the continuous load.

This is indeed a lengthy reply, but we hope it will bring out the inadvisability of giving any one answer.

Switch Connection

Q. *(1) "The diagram (Fig. 1) shows a switch and fuses connected to the line. If you will notice, the fuses and blades of the switch are on the live side continually which presents the danger*

***KEEPING IN STEP** with wartime developments along the electrical contracting front are (L to R) Harold B. Gelders, Grand Rapids; Ed Baker, Cass City; Bill Sayles, Vassar; and Rollie Taylor, Tuscola, all contractors in the Wolverine State. The plight of the small electrical contractor was the topic under discussion.*

ARROW AUTOMATIC SCREW MACHINE DEPARTMENT

Planning the use of new tools to make two hex nuts in one cycle of operation.

Operator gauging a part produced on a Davenport Screw Machine.

Silver-rolled contacts being precision-made on Brown & Sharpe Screw Machine.

Foot Press Department where screw machine parts are formed and pierced.

Milling machine cutting off four contacts in single operation.

General view of Brown & Sharpe High-Speed Rod Magazine-Feed Screw Machines.

Equipped and manned for parts-accuracy

The higher the quality of Wiring Devices, the higher the ratio of machined parts to stamped parts required. This accounts for the unusual proportion of *machined* bushings, sleeves, shafts, levers and spindles in ARROW Devices.

These are the parts that tie all assemblies together. On their accuracy depends the fit and alignment of switch mechanisms. Their uniformity, as interchangeable units, governs *smoothness of action* of all moving members of wiring device assemblies.

In this Department, the machining of parts — despite the demands of quantity production — is held to tolerances as close as .0005". What this does for the products' PERFORMANCE, our customers have known for more than a half-century.

Milling the side of a contact to exact measurements prescribed.

Precision grinding of chaser, where extreme accuracy must be achieved.

Setting up new tools to make two hex nuts in one complete cycle of operation.

Drilling holes on lever at the rate of twenty-three hundred per hour.

Separating oils from parts and chips by use of centrifugal oil separator.

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

YOU CAN'T PREVENT LIGHTNING—

BUT YOU CAN TAME IT

TO PROTECT VITAL WAR PRODUCTION!

VITAL war production must be maintained at all costs today. That is why the safeguarding of life and property against accident, sabotage, and even Nature's destructive weapon of lightning has taken on new importance.

That is also why West Dodd Lightning Protection and static control equipment is being widely used on Army Ordnance Plants in all parts of the country. Helping protect ammunition loading lines, underground magazines, standard magazines, and bag loading buildings.

Many important industrial plants also have West Dodd protection on their power stacks.

WEST DODD PLUS FACTORS

West Dodd represents a consolidation of 12 old line manufacturers, including the famous Dodd & Struthers Company, pioneer of approved lightning protection. This wealth of experience and a long proved record of responsibility are two plus factors.

FREE assistance in planning installations and estimating costs. Telephone or telegraph today.

The West Dodd end aerial, complete. In center is the exclusive West Dodd cable and point connector. It eliminates sharp bends formerly necessary to bond aerial and conductor. Quicker to install. Eliminates a number of connectors. Simplicity adds to efficiency and longer life.

This is one of many West Dodd items developed to meet U. S. Government requirements, cut installation time, and save labor costs while aiming at more lasting, thorough protection.

TELEPHONE OR TELEGRAPH TODAY!

WEST DODD

LIGHTNING CONDUCTOR CORP.

GOSHEN, INDIANA

Questions on the Code

[FROM PAGE 134]

of shock not only in replacing fuses but when throwing the switch. I was told by an electrician that the rule for fuses is that they should always be between the switch and the line. It seems obvious to me that the line should always be connected to the jaws of the switch and the load should be connected to the fuse side. In other words, the exact opposite of (Fig. 1). Is this true?"—M.M.

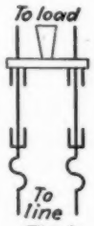


Fig.1

A. (1) The connections should be such that the jaws of the switch only are alive when the switch is open. It is a violation of Section 3807 of the Code to have the blades alive when the switch is open. Also, according to section 3885 the switch should not be on the load side of the fuse. While this latter rule applies to switches on panelboards it should be followed with all fused switches.

Q. *(2) "Figure 2 shows a diagram of a shunt motor and starting box connected to a D.C. line. I think that the line wires should really be reversed because the starting box arm which is the switch in this circuit is connected to the negative or neutral wire."—M.M.*

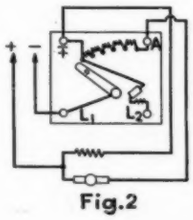


Fig.2

A. (2) In the case of a rheostat starting box as shown above, the hot wire should be connected to the Line (L) connection, when used on 120 volt single phase, in order that the contact buttons may not be alive when the switch is open. If used on 220 volts with both wires alive to ground it would make no difference which way it is connected.

Of course there should be a disconnect switch ahead of this starting box.

Outlet Box Position In Wall

Q. *"A question has been raised regarding violation of Section 3711 of the Code during the erection of the walls in dry wall construction.*

"After we install our boxes and cable the carpenter erects a piece of sheet rock or plaster board the entire width or height of the room. He is then supposed to cut out an opening around our boxes.

"In most cases he has a great deal of difficulty in doing a good job and often, especially on the ceiling, forces our boxes back so that they rest on top of the plaster board or sheet rock. In these cases the edges of the boxes are from ⅜-in. to ⅝-in. behind the finished surface of the wall or ceiling.

"If the openings for the boxes were cut out large enough to make certain that the edges of the boxes would be flush with the finish, the contractor would have to do a great deal of plastering between the boxes and the finish and greatly increase the cost of this type of construction.

"We would greatly appreciate an opinion as to whether, in this type of construction, boxes being up to ⅝-in. behind the finished surface will be approved by the Code."—R. C.

A. Prior to the 1937 edition of the Code the requirement that outlet boxes be set not more than ¼-inch back of the finished surface specifically did not apply to "walls or ceilings of concrete, tile, or other non-combustible material." (See 512j, 1935 Code.)

But the 1937 Code reversed this and the requirement now is that in walls or ceilings of concrete, tile or other non-combustible materials the boxes shall be installed so that the front edge is not more than ¼-in. back from the finished surface.

The thing to do, therefore, is to set the boxes so that their outer edges will be not more than the limit of ¼-inch back of the surface of the finished wall.

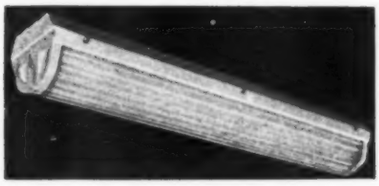
CONSTRUCTION SUPERINTENDENT *E. C. Jarchow, Miller-Seldon Electric Co., Detroit, Michigan, works on an $80,000 motor order. And he hopes the wiring contract will follow. Mr. Jarchow is a staunch advocate of busway systems for flexibility and salvability.*

You can do it quicker with a
QIKLUG
QIKLUG
Type QA
Compactness is an outstanding Qiklug feature. The Qiklug is quickly and rapidly installed even in limited working space.
Qiklug variations are available for multiple cable accommodation, unusual angles, long cable drops and other requirements.
Write for Catalog No. 41, listing other Burndy Connectors
BURNDY
107 EASTERN BLVD.
NEW YORK, N. Y.

EQUIPMENT News

Fluorescent Fixture

The new "Safirelite" series of fluorescent luminaires is obtainable for one, two, three or four 40 watt lamps. It is designed for either pendant or surface mounting, and is equipped with knockouts in each end permitting either single or continuous strip installation in either type of mounting. Fixture body is steel, with metal frame and metal ends. Alba fluted glass encloses tubes and reflecting surfaces. Fixtures are furnished wired complete with sockets, lamp starters and high power factor ballasts. Lighting products, Inc., Highland Park, Ill.



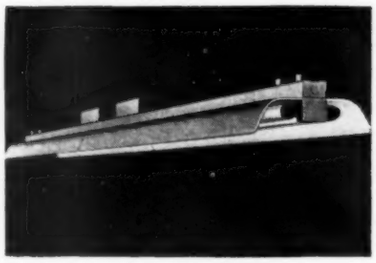
LIGHTING PRODUCTS FIXTURE

■

Lighting Fixtures

A new line of RLM approved lighting fixtures for industrial applications has been announced. It includes single RLM units with open end removable porcelain enamel reflectors and the Day-Line RLM series of continuous fixtures. All of these fixtures are listed for two and three 40-watt lamps and two 100-watt lamps. The 100-watt reflectors are available with or without diffuser slots. A basic channel design is used in all of these fixtures to facilitate installation and servicing, and fittings are listed for pipe, chain, messenger cable and direct ceiling mounting. Day-Brite Lighting, Inc., 5411 Bulwer Avenue, St. Louis, Mo.

DAY-BRITE LIGHTING FIXTURE



CURTIS INDUSTRIAL UNIT

Fluorescent Unit

A new fluorescent industrial unit with non-metallic reflector has been designed for war production industries. Units use CurtiStrip wiring channel and are for two or three 40-watt lamps or two 100-watt lamps per reflector. Eight or ten foot sections may be joined for continuous runs of any length, or reflectors may be omitted when desirable without interfering with continuous wireway. Ballasts and starters are mounted on top. The reflector is made of Fluracite. Curtis Lighting, Inc., 6135 West 65th Street, Chicago, Ill.

■

WIREMOLD "3000" SYSTEM-WIRING

System-Wiring

Wiremold "3,000" system-wiring is for industrial plants and offices. It provides complete surface wiring layout for lighting and portable tool or appliance power outlets in production areas, engineering departments, laboratories and plant office buildings. The No. 3000 channel and special hanger fittings permit spanning of beams. Minimum number of "slip joint" fittings cover all installation methods and requirements. Installations for fluorescent lighting of working areas can be completed using same basic No. 3000 channel with reflectors, ornamental glass enclosures, hangers and fittings for both unit type or continuous Line-O-Lamps fluorescent fixtures. The Wiremold Company, Hartford, Conn.

McGILL SWITCH

Switch

No. 41 Levolier switch has been redesigned in order that brass may be released for production of shell casings. New switch is known as No. 41-B and is made with a plastic casing, steel lever, nut and chain. It is compact, light in weight and sturdy. Elimination of cap used on brass switch facilitates affixing of wires and assembly of switch. A flat spring catch, when pressed, releases switch mechanism from plastic shell for wiring. Reassembly is accomplished by pressing mechanism back into shell until spring catch snaps into place. McGill Manufacturing Company, 259 Indiana Ave., Valparaiso, Ind.

■

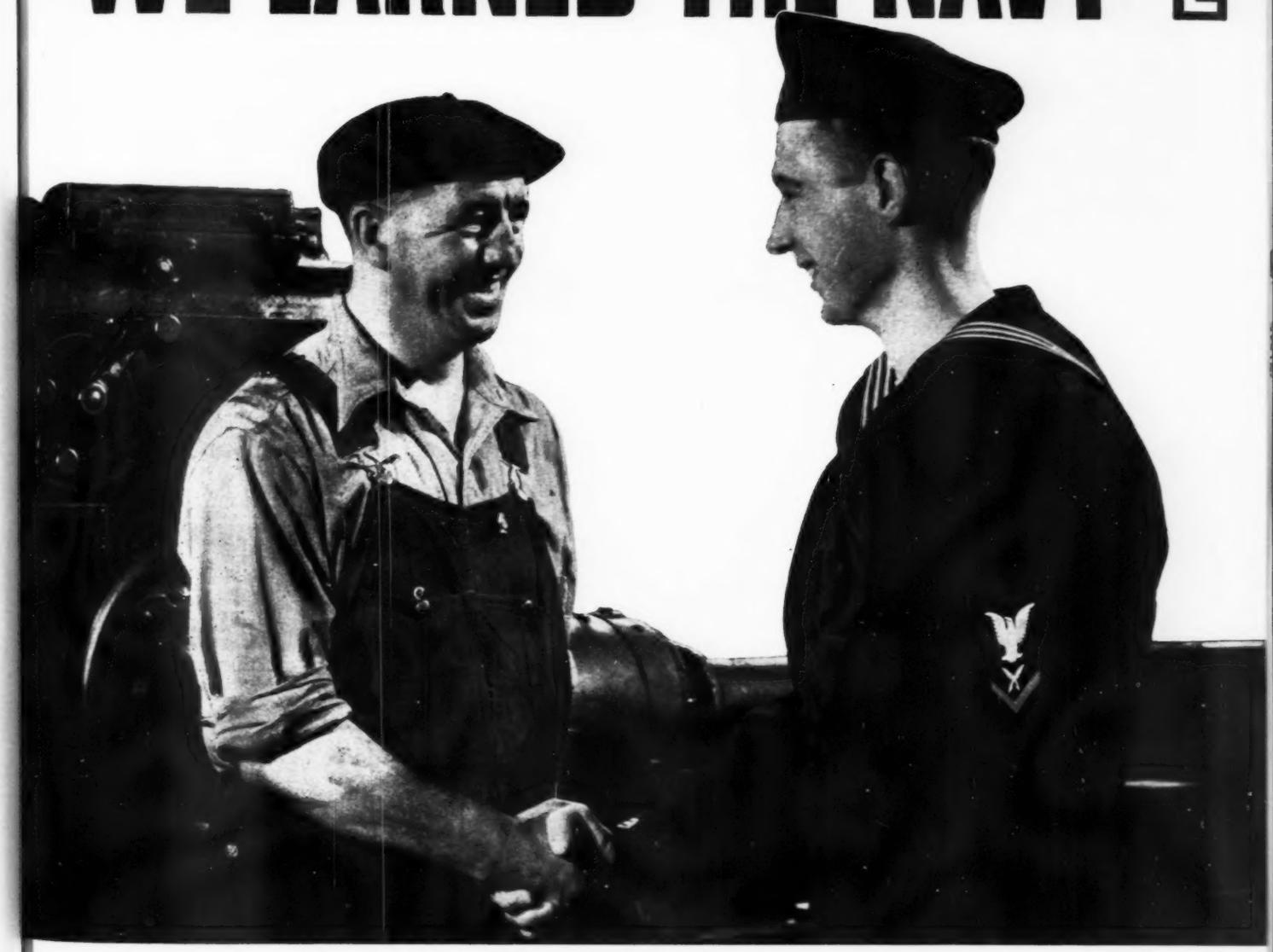
Floodlight

A new glass floodlight combining the high reflectivity of silvered glass with unusual resistance to shock has been developed. Glass is shatter-proof. Reflector is coated by electrolytically deposited metal which together with an over-all backing of porcelain enamel will keep glass from shattering if it is broken by a severe blow. Reflector is joined to a metal socket housing which is sealed with a heat-resistant gasket and which acts as a preventative against entrance of water, making floodlight corrosion-proof. Door glass and gasket fit solidly against reflector. It is known as G-E Type L-49. General Electric Co., Schenectady, N. Y.

G-E GLASS FLOODLIGHT

Sailor—

WE EARNED THE NAVY "E"



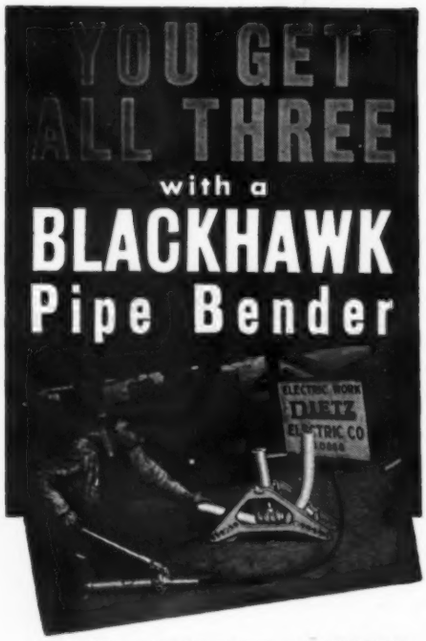
Our pledge to the Navy

To the United States Navy and to the Nation, we of American Blower pledge the unstinted devotion of our experience, our ability, our effort. Whether destined for use on the battle lines, or to equip other essential industries for production of vital material—the products of our efforts, we pledge, will continue to measure up to the standard of excellence that is worthy of the commendation, "Well Done." We are proud of the privilege of working under the Navy "E" burgee—proud to wear the insignia conferred on us. By our progress in production, we shall continue to demonstrate our patriotism and determination to win. We are mindful of our responsibilities. We are working, and shall continue to work, for Victory!

MECH. DRAFT · AIR-CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN Radiator and "Standard" Sanitary Corporation



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that can be used separately from the bending attachments. Here is the triple utility:

1 PIPE BENDING

Smooth, remotely controlled hydraulic power bends rigid conduit and pipe up to 4" diameter. Saves need for elbows and couplings and otherwise necessary cutting and threading.

2 MAINTENANCE AND PRODUCTION

Big range of attachments adapt the hydraulic unit to push, pull, bend, press, spread and clamp work. Pull gears and pulleys, lift machinery, (as shown at left)—do scores of other jobs allied to pipe bending.

3 SPECIAL JACK

Compact 10 or 20-ton ram (same as used in pipe bending) works in all directions — and at any angle. Preferred to all other types of jacks.

MAIL COUPON TODAY

BLACKHAWK MFG. COMPANY
Dept. P2072, Milwaukee, Wis.
Send Full Information on your Pipe Benders.

Name.....

Company.....

Address.....

EQUIPMENT NEWS

[FROM PAGE 138]

Switch

Additions have been made to this line of RTS switches. There is available a pull-out switch with spring return, a push-in type with spring return, either potential or current units, "make before break" or "break before make" switches, momentary contact switches, made up in one, two or three units operated by one knob. Type RTS reduces relay test time as tester is not required to change wiring, no wrong connections are made after test, and construction prevents leaving current transformer shorted. Supplied in single or multiple units for $\frac{1}{8}$-in. up to and including 2-in. panels. The States Company, Hartford, Conn.

STATES RTS SWITCH

■

Transformer

New standard type "CT" indoor current transformer with Hipersil core has been announced. They have a current rating of from 10 to 800 amperes primary and 5 amperes secondary; voltage ratings are 5, 8.7 and 15 kv. Definite primary terminal dimensions are set for distance between centers of outside terminal holes, size of hole, size of slot, distance from base to under side of terminal and overall height from mounting base to top of transformer. Any standard type "CT" transformer is interchangeable with any other in its voltage class, regardless of current rating. Westinghouse Electric and Manufacturing Co., Sharon, Pa.

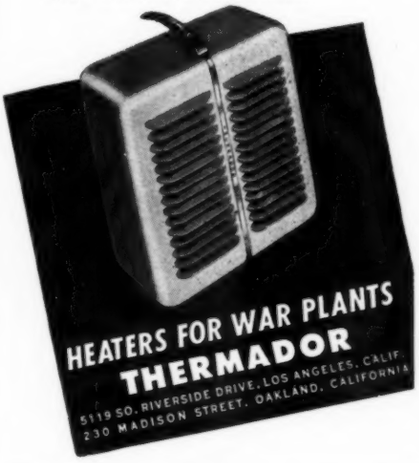
WESTINGHOUSE TRANSFORMER

COOLS IN SUMMER

HEATS IN WINTER

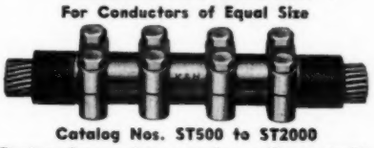
Watch production soar when you install these Portable Electric Heaters. Enclosed fan forces out warmth or circulates cooling air.

Equipped with four-position switch: cool, half heat, full heat, off. 8 feet cord, polarity plug. 230 Volts—50 or 60 cycles A.C., Single Phase. Sizes to 5000 Watts. Write for details.



K&H Solderless Terminal LUGS — A SIZE and TYPE for every need! — K&H Solderless CONNECTORS

STRAIGHT CONNECTOR
For Conductors of Equal Size



Catalog Nos. ST500 to ST2000
Designed to resist excessive pull-out strain.

ADJUSTABLE STRAIGHT CONNECTOR
No Removable Parts

Catalog Nos. CR4 to CR8

UNIVERSAL STRAIGHT CONNECTOR
Both ends of this Connector are Adjustable

Catalog Nos. O4 to O201
Eact end fits over moderate range of conductor sizes.

WRITE FOR CATALOG 3LC

KRUEGER & HUDEPOHL
232-8 VINE ST. · · · CINCINNATI, OHIO

HERE'S COMPLETE INFORMATION

on all types of

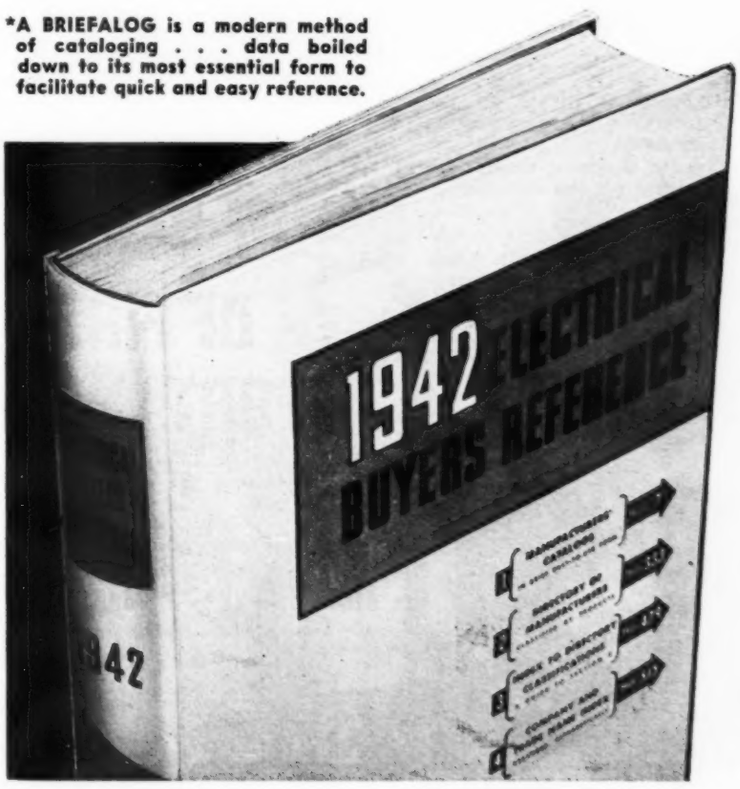
SWITCHBOARDS, PANELBOARDS AND SWITCHGEAR

In the fact-filled pages of the 1942 Electrical Buyers Reference, 15 manufacturers of switchboards, panel boards and switchgear have boiled down into compact easy-reference form all essential data on their products. They have included information to help you compare, select, specify and buy: they've listed complete specifications regarding capacities, operation, dimensions, construction, and usage-recommendations for each piece of equipment, also their branch offices, warehouse addresses, etc.—all possible "buying-aid" information to save your time.

This condensed "Briefalog"* form eliminates the bother of searching through lengthy catalogs of various manufacturers (if you have them!). 255 other manufacturers of electrical and kindred equipment tell similar product stories in this complete compilation of supply sources.

Turn to Electrical Buyers Reference *first* for help in solving your specifying and purchasing problems!

*A BRIEFALOG is a modern method of cataloging . . . data boiled down to its most essential form to facilitate quick and easy reference.



These 15 manufacturers of

SWITCHBOARDS, PANELBOARDS AND SWITCHGEAR ANSWER YOUR QUESTIONS IN THEIR *Electrical Buyers Reference* "BRIEFALOGS"

Cutler-Hammer, Inc.
Frank Adam Electric Co.
Bull Dog Electric Products Co.
Heinemann Circuit Breaker Co.
Metropolitan Electric Mfg. Co.
Plainville Electrical Products Co.
Trumbull Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Wurdack Electric Mfg. Co.
General Electric Co.
Pennsylvania Transformer Co.
Allis-Chalmers Mfg. Co.
Bull Dog Electric Products Co.
I-T-E Circuit Breaker Co.
Roller-Smith Co.

ELECTRICAL BUYERS REFERENCE
A McGraw-Hill Publication
330 West 42nd Street New York

QUIZ—on Private Telephone Systems

Contractors Are Asking How Priorities Affect Our Supply of Private Telephone Systems

Here's How We Stand to Date

Q. *Are Automatic Electric Telephone Systems available to my customers?*

A. Yes. If they are engaged in vital war work we believe we will be able to meet their needs.

Q. *Are there restrictions on available types?*

A. Yes. We have discontinued the manufacture of Idealfones and Auto-Coms for the "duration," but we are still making a complete line of P-A-X systems and Inter-Coms to meet practically all requirements.

Q. *How do priorities affect the sale of private telephone systems?*

A. We believe your customer will be able to obtain a P-A-X system or Intercom system if he is engaged in vital war work, enabling him to acquire a high preference rating for his order.

Q. *How will a private telephone system help my customers' war efforts?*

A. By saving many steps for key men. By speeding up inside communication. By cutting delays and errors. By removing the inside traffic from the city telephones. By improving executive supervision.

Q. *Why should I recommend an Automatic Electric P-A-X or Inter-Com?*

A. Because these systems are made by the originators of the automatic telephone—the company which has been most instrumental in developing and extending automatic telephony. Because the makers have had long years of experience in building telephone systems for public use—the hardest of all types of service. Because P-A-X and Inter-Com systems have proved their worth to hundreds of private organizations and government departments all over the world. And because there is a system that covers every need—whether for two telephones or a thousand.

FOR INFORMATION about our private telephone systems see your local electrical wholesaler, or get in touch with the nearest Automatic Electric representative. Our Sales Engineers are always glad to work with you in selecting the system best adapted to your customers' needs.

AUTOMATIC ELECTRIC

Private Interior Telephone Systems

Distributed by:
American Automatic Electric Sales Company
1033 W. Van Buren Street, Chicago, Ill.
Sales and Service Offices in Principal Cities
In Canada:
Canadian Telephones & Supplies, Ltd.,
Toronto, Ont.

EQUIPMENT NEWS

[FROM PAGE 140]

Siren

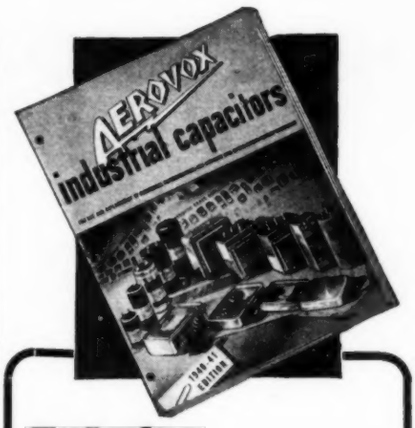
This air-raid siren, known as Tornado, is specially designed for industrial use. Two models are available. One is for small departments, offices, laboratories, stock rooms, etc. and a larger one for the manufacturing areas which will be heard above the usual din of machines at work. Sirens are equipped with Universal motors for either alternating or direct current. They operate from any ordinary light current, making them effective at any minute of the hour, day or night. They are equipped with base for either vertical or horizontal mounting. Breuer Electric Mfg. Co., 5100 Ravenswood Ave., Chicago, Ill.

BREUER TORNADO SIREN

Relay

A new sensitive direct current relay for aircraft service has been announced. The relay, designated CR2791-C100C, is designed for use in vacuum tube output circuits where power available is so small as to require operation on extremely low currents. A sealed aluminum cover protects relay from dust. It has a maximum continuous current rating of 2 amperes at 32 volts and a maximum make or break rating of 10 amperes. The coil is rated at 32 milliwatts minimum and 1 watt maximum. Maximum coil resistance is 3000 ohms. The contacts provide single-pole, double-throw operation. General Electric Co., Schenectady, N. Y.

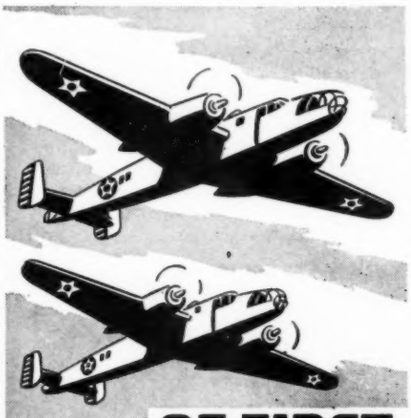
G-E RELAY



Ask for Your Copy . . .

● **Here's the combined manual and catalog on motor capacitors. Just the practical data you need in servicing capacitor-start refrigerators — diagrams, charts, formulae, plus complete handy listings of all standard capacitor-start motors and their capacitor requirements. Handy cross-index of Aerovox capacitors and motor manufacturers' parts numbers. • Simply ask your jobber for a copy. Or write us direct.**

AEROVOX CORPORATION
NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., Hamilton, Ont.
EXPORT: 100 Varick St., N. Y., Cable 'ARLAB'



OF FIRST IMPORTANCE

Right now it's an all-out effort for Victory—but in the years ahead we shall make Signal products the ultimate in quality and price, as in the past 50 years. Quality is still our principal product.

SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan
Offices in All Principal Cities

SIGNAL

Socket

A new adjustable swivel socket is available. It directs beam of projector spot or floodlight • bulb to any desired position. Socket is so constructed that the connecting wire leads cannot cross or get twisted. It is supplied with special live rubber gasket to hold adapter in outlet, preventing socket shell from pulling out or adapter turning around. All porcelain parts white glazed. Socket has center contact which will retain its spring tension against base of bulb. Kulka Electric Mfg. Co., Inc., 30 South Street, Mount Vernon, N. Y.

KULKA ADJUSTABLE SOCKET

■

Instrument

Model 520 insulation and breakdown tester features a danger indicator which lights up to indicate leakage up to 1,000 megohms. Four voltage sources are available 250, 500, 1,000 and 2,500 volts. To use, connect the two test leads to the circuit, appliance or motor to be tested, then throw the switch. Danger indicator will light up to indicate defective insulation, or insulation which, because of its excessive leakage, indicates a potential or imminent breakdown. It will also indicate "shorts" and "opens". Instrument is housed in a portable carrying case with compartment for test leads. It operates on any 90 to 125 volt 60 cycle a.c. line. Superior Instruments Co., 227 Fulton St., New York, N. Y.

SUPERIOR TESTER

Since 1857

KLEIN TOOLS

Better Tools for Tough Jobs

KLEIN'S

Your copy of the Klein Pocket Tool Guide will be sent on request.

ASK YOUR SUPPLIER

Climbing poles—keeping power and communication lines open is no easy task at best. Under war-time emergencies the job of the nation's linemen becomes increasingly tough.

But his knowledge and skill—his experience—the equipment he uses are the country's guarantee the job he does will be *well done.*

That these men prefer Klein pliers and tools, Klein belts and safety straps, Klein grips and climbers, is high testimony to the high quality of this equipment that has been serving America since 1857.

In the present emergency when tools and equipment are growing scarce, Kleins are proving their value in the years of service they give.

***Foreign Distributor:* International Standard Electric Corp., New York**

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE CHICAGO

VITAL TO VICTORY

Ultimate Victory depends upon all-out operation of mines, shipyards, steel mills, munition factories and manufacturing plants that turn out a multitude of products necessary for military operations. Such production is of vital importance and must be kept in full operation.

Nearly all of this production is dependent to a large degree upon electric power and upon the electrical conductor by which it is brought to the point where it is needed. The necessity for careful selection and proper installation and maintenance of insulated wires and cables cannot be over-emphasized. Under existing conditions it is advisable to take the best of care of the insulated cables now in use and to consider nothing but the best that can be made under present restrictions if new cables must be purchased.

This is particularly true now when conservation regulations interfere with the full use of scarce materials ordinarily used in insulations or coverings. Many important critical materials are used in Simplex cables. They can be used now only under conservation restrictions and for essential industries with high priority working on war orders.

SIMPLEX WIRE & CABLE COMPANY

79 Sidney Street, Cambridge, Massachusetts

MINERALLAC HANGER

Conduit 3/8"—2 1/2"
Cable to 2 1/8" (with Bushings)

Cadmium and Everdur
MINERALLAC JIFFY CLIP

Sizes from .250" O.D. Tubing to 1 1/4" conduit.

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ELECTRICAL CONTRACTING
330 West 42nd Street,
New York, N. Y.

EQUIPMENT NEWS

[FROM PAGE 143]

Capacitors

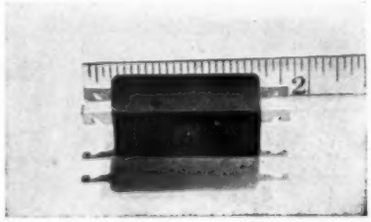
Type XJ high voltage filter capacitors provide a wide range of capacities in d.c. voltage ratings from 6,000 to 25,000. Containers are heavy gage steel, welded oil tight and hot tinned. The wet process porcelain insulators are proportioned to withstand potentials in excess of the rated voltage of the capacitor. Case and terminals are bonded together by gasket material. The vacuum treated mineral oil impregnant assures low leakage current and negligible capacity change over a wide range of operating temperature. Solar Mfg. Co., Bayonne, N. J.

SOLAR CAPACITORS

■

Switch

This new switch is specially designed for use in aircraft applications where space is limited and where vibration conditions are severe. It is called "switchette" and weighs only 9 grams. It can be operated by lever, bellows or other actuating means by movement of a spring return button in housing. Contacts are arranged for single-pole normally open, single-pole normally closed, or single-pole double-throw operation. Each form is available with contact air gap of 0.010, 0.020 or 0.030 inch. Overall dimensions are—length 1 3/4 in.; depth 10/32 in. and width 1/4 in. General Electric Co., Schenectady, N. Y.



G-E SWITCHETTE

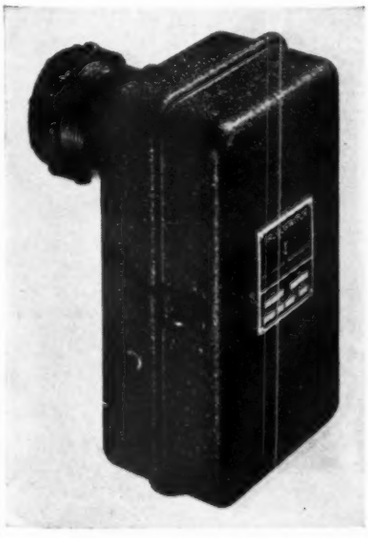
Fluorescent Lighting Unit

This new fluorescent lighting unit is known as Plastilux, and is for use in offices. It has a steel top plate and plastic diffuser. It is designed for installation in continuous lines or for individual units, to be mounted either directly on ceiling or suspended with hangers. Knockouts are provided in top plate. Unit accommodates two 40-watt 48-inch fluorescent lamps. Outer surface of top steel plate acts as a reflecting surface and has a Fluracite finish. It is wired complete with 110-120 volt high power factor ballast. Curtis Lighting, Inc., 6135 West 65th Street, Chicago, Ill.

CURTIS PLASTILUX FIXTURE

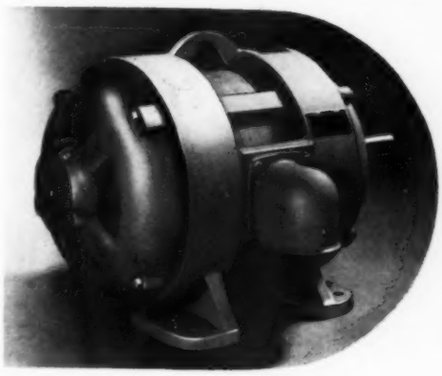
Switch

This photoelectric switch is to control lights in store windows and outdoor signs where blackout regulations are in effect. Switch is located on billboard or in store window which is to be operated. It is aligned with nearest street lamp. When this centrally controlled street lamp is turned out, the switch turns off the illumination which it is controlling. It operates from a supply of 115 volts, a.c. and controls in its output 20 amperes at 115 volts. Types are also available for d.c. operation. Photoswitch Incorporated, 21 Chestnut Street, Cambridge, Mass.



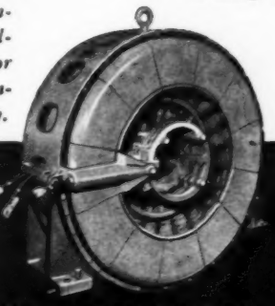
PHOTOSWITCH BLACKOUT CONTROL

BURKE *Induction* MOTORS



Investigate Burke's line of Induction Motors for application from 1 to 1500 H.P. All welded frames, no rivets or bolts—air gap held to very close limits—all coils are form wound and treated with plastic, age-resisting composition, vacuum impregnated. Individual coils easily replaced — a modern sturdy design.

Burke Motors available in all forms and types. Multi-speed —drip and splash proof—enclosed fan cooled—vertical-flange—round frame—elevator —crane and hoist, etc. for continuous and short time duty.



WRITE FOR BULLETIN 101-A

BURKE ELECTRIC CO.
ERIE PA., U.S.A.
AC & DC GENERATORS · EXCITERS
AC & DC MOTORS · TERMINAL BLOCKS
MOTOR GENERATOR SETS

CHANGED YOUR ADDRESS?

Copies of ELECTRICAL CONTRACTING, to have their full value, should reach you promptly and with no inconvenience. This we constantly strive to do.

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In the News

FIXTURE FREEZING ORDER RELAXED

Non-industrial types of fluorescent fixtures—those using tubes rated at 30 watts or less—may now be sold without restriction under an amendment to WPB order L-78 issued on June 13. The modification opens the door to sales of such fixtures as the popular 20-20 kitchen unit and similar sizes.

Formerly, the order exempted only fixtures with tubes of a total of 30 watts or less. Under the June 13 change the unrestricted class is broadened to include all fixtures using tubes (one or more) of 30 watts or less each.

Another important change is extension of the expiration date of the order to September 1. This alteration was inserted by the lighting fixtures section which administers the order so as to remove the restraints dealers have felt against stocking up due to uncertainty over future regulations. The order had been written to expire June 30.

Permission is granted in the amendment to manufacturers to complete construction of cold cathode fixtures from materials already fabricated. Another modification permits manufacturers to exchange fabricated parts in order to assemble complete fixtures from materials already partly processed and in stock.

Three other changes from the previous order apply to distribution and sales. Replaceable starters are eliminated from the restrictions of the order on the ground that they are replacement parts —other replacement parts always have been exempted. It is also permitted that manufacturers or distributors may ship fixtures for storage to any point and/or within branches of a single enterprise.

Distribution of fixtures also is permitted for purposes of demonstration and tests. This move is an effort by the fixtures section of WPB to encourage the demonstration of new types of units made with less amounts of critical materials.

This amendment does not incorporate the restriction forbidding use of steel in fluorescent reflectors which, it has been announced, is under consideration. In addition to the possibility of banning steel from reflectors, it is now understood the section is studying the advisability of prohibiting steel in other parts of the fixture as well.

MEMPHIS RULES ON BUILDING PERMITS

The city of Memphis, Tennessee, through a unique ruling by the Building Commissioner, maintains rigid control over the quality of electrical work done within its jurisdiction.

The rule, which has been successfully operated since last summer, makes it mandatory that the electrical, plumbing, and heating permits be issued before a contractor or builder can obtain the building permit. And this applies to remodeling as well as new work. Since permits are issued only to licensed contractors, quality workmanship and materials are assured.

The advantages of this type of regulations are three-fold: the city can control wiring standards since all work done on permits is done by licensed electricians and passed by the city electrical inspection department; the contractors know that approved materials will be used and that their industry will not be raided by unlicensed, unqualified competition; the public is assured of safe, high quality electrical installations.

CONSTRUCTION BUREAU MOVED TO NEW YORK CITY

The Bureau of Construction, recently established to coordinate all construction functions of the WPB, has moved from Washington to New York and opened headquarters in the Empire State Building.

Except for a small office staff which will remain in Washington for liaison work, the entire organization under William V. Kahler, chief of the Bureau, is affected by the change. Thomas L. Peyton, assistant to the chief, will be in charge of the Washington office.

The Bureau is divided into five operating branches: Project analysis branch, materials control branch, project service branch, housing branch, and consultation branch.

The Project Analysis Branch handles all applications for private construction and recommends priority ratings for them. It administers limitation and conservation orders covering construction. Various agencies interested in construction have designated representatives to be stationed in New York to work with the Bureau in determining the essentiality and urgency of projects.

These include the Materials Division, Bureau of Industry Branches, Bureau of Priorities, Bureau of Governmental Re-

NEW OFFICERS of the Tennessee Electrical Contractors Association are (L to R) P. H. Sweet, Chattanooga, secretary-treasurer; Herbert Haile, Chattanooga, president; C. R. Wright, Knoxville, retiring president and executive committeeman; A. C. Gross, Memphis, 2nd vice-president; G. W. Hoffman, Knoxville, 3rd vice-president. Ray Edenfield, Nashville, is the 1st vice-president and A. J. Thompson, Memphis, the other new executive committeeman.

AN ELECTRICAL WHOLESALER HELPS SPEED WAR PRODUCTION

WESCO "invented" light to store explosives

WESCO SPEEDS PRODUCTION

* 2½ acre Army building was rushed to completion in 60 days through Wesco's ability to maintain 24-hour a-day warehousing facilities and delivery service.
* Wesco's delivery of 23 items within one day to a shipyard saved nearly 2-months delay, maintained construction schedule and kept hundreds of men on the job.

WESCO SERVES BUSINESS

* By providing trained sales and engineering personnel.
* By offering prompt delivery of electrical items from large stocks.
* By extending credit to help finance jobs.

Added 12 Safe Night Hours to Work Time in U. S. Ammunition Depot

A huge ammunition depot, piled to the skylights with bombs, shells and other explosives, was ordered on a 24-hour schedule. But, there was no light at night! No glass windows! No electric current; and wiring was forbidden! Problem—to provide light at night—in 3 weeks.

A Wesco engineer figured you could shoot light from outside the building through iron ventilation shutters, and bounce it off the ceiling into the canyon-like aisles inside. Four 1000-watt floodlights were hung on the shutter sills. Power was supplied 100 feet away from the building by portable gasoline engines, driving Westinghouse generators.

Devising the scheme and completing the job in 3 weeks is typical of the ingenuity and intelligence Wesco brings to customers' problems—now to speed Victory; later to serve peacetime business.

The name that means everything in electricity

Westinghouse

ELECTRIC SUPPLY CO.

150 VARICK STREET · NEW YORK, N. Y.

A NATIONAL DISTRIBUTING ORGANIZATION WITH 79 BRANCHES

[FROM PAGE 146]

quirements, the Army-Navy Munitions Board, the Plant Site Board, the Federal Works Administration, the Federal Housing Administration and the Federal Public Housing Authority.

The Materials Control Branch reviews the use of materials in projects which have been designated as essential by the project analysis branch. The former branch is guided by criteria established in the Bureau of Industrial Conservation, WPB, and applies these principles to insure a minimum use of critical materials.

The Project Service Branch works closely with industry and with the Army, Navy, Defense Plant Corporation, and other Government agencies, rendering whatever service is needed to eliminate construction delays so that scheduled completion dates are met. It advises and assists these groups on design and construction matters including the procurement and expediting of needed materials.

The Housing Branch recommends priority ratings for publicly and privately financed war housing. It works closely with other housing and related agencies in the Government, reviewing with them such matters as the type of housing as it relates to the use of materials, availability of utilities, services.

The Consultation Branch acts as liaison between the public and the Bureau. It interprets the needs and problems of the construction industry and recommends procedures consistent with the over-all war program. Through its knowledge of trends and the requirements for essential military construction, the branch recommends the issuance of limitation and conservation orders and amendments, as may from time to time become necessary.

Direction and decisions of the Bureau will be handled in the New York Office.

All contacts with Federal, State, and local government agencies in regard to applications concerning their construction projects are the function of the bureau of governmental requirements, under the direction of Maury Maverick. This branch, part of the Division of Industry Operations, will remain in Washington.

The facilities of several other agencies of the Government have been made available to the War Production Board for receiving and processing applications for authorization to begin construction.

Applications for farm building, either agricultural or residential, should be filed with the local county and State War Boards of the United States Department of Agriculture which recommends essential building to the Bureau of Construction for approval.

"GOOD STUFF," comments Glen Sebastian (left), Albion, Mich., as he compliments Jay Biddle, secretary, Wolverine State Electrical Contractors Assn., on the timely priorities information contained in the Association paper and the fine program at the recent convention in Detroit.

Applications for residential building, other than on farms, should be filed at local office of the FHA. Publicly and privately financed defense housing programs also are processed by the FHA. Recommendations are made by FHA to WPB, but in each instance final approval for a project must be given by the Bureau of Construction which then assigns it a priority rating.

Applications for commercial and other construction should be filed directly with the Bureau of Construction. Each project of this type is reviewed by an end-product branch in the WPB which makes recommendations as to essentiality and urgency to the Bureau.

Correspondence concerning projects handled by the Bureau of Construction should be addressed to: War Production Board, Bureau of Construction, Empire State Building, New York, N. Y.

"Dad had a time switch installed—Lights go back on at 10:30 sharp."

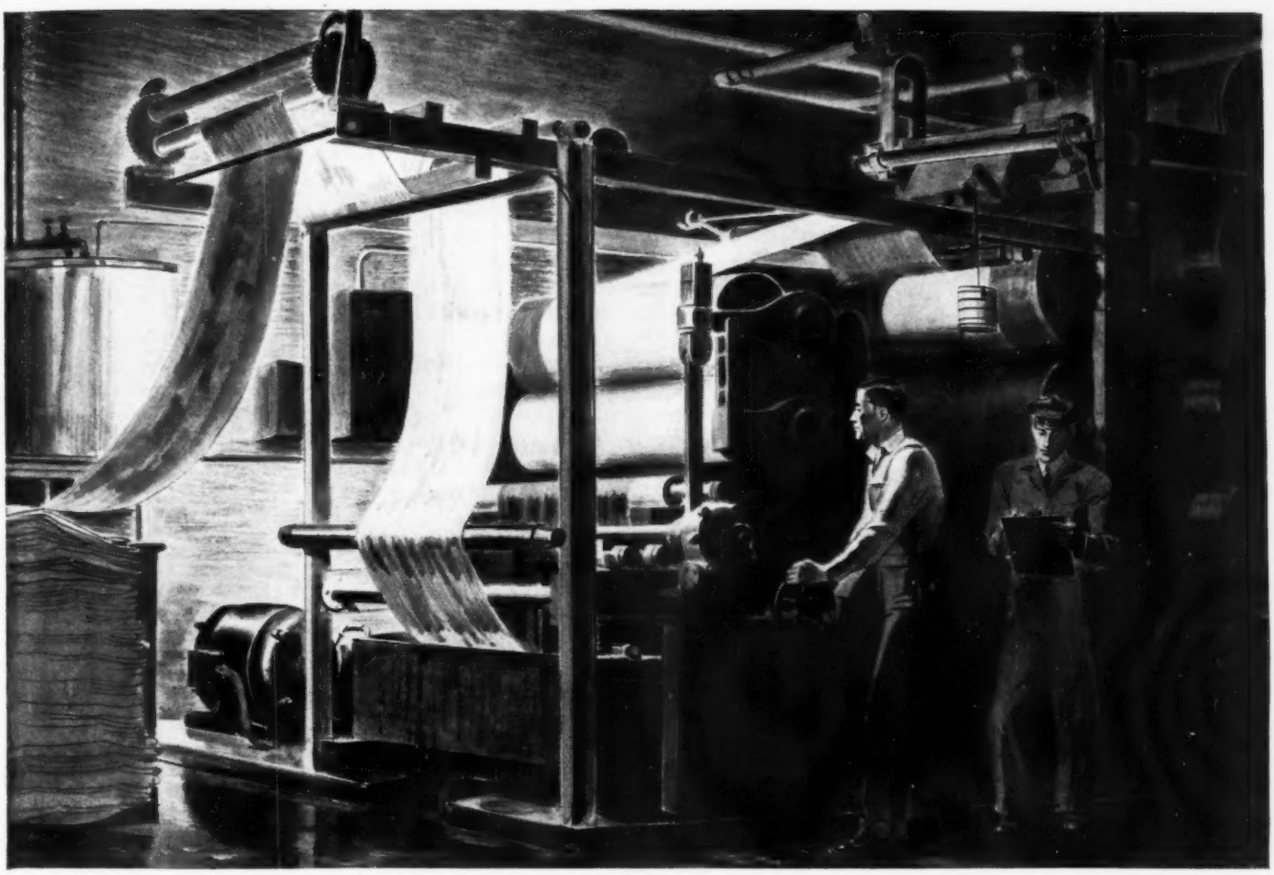
EAST DIM-OUT CUTS DISPLAY LIGHTING

Dim-out regulations for the East coast line area issued by Major General Terry, reduce exterior and display lighting and require screening of interior illumination.

All lights normally visible from the sea must be shaded so that they will not be visible more than a mile out. All exterior lights must be reduced to minimum intensity and shaded to prevent direct rays above the horizontal.

Store lights must be shaded to prevent direct rays outside, window lighting and lighting under theater marquees and similar areas must not exceed $\frac{1}{4}$ watt per square foot.

The orders relating to lighting under dim-out restrictions are as follows:



The motors that licked the "time killers"

Caustic fumes...heat...were causing frequent insulation failures. How electrical engineers stopped them with the help of Fiberglas*:

★ ★ ★

A southern finishing mill converts khaki for Uncle Sam from grey goods. Motors in their plant are constantly sprayed by steam and caustic fumes. Combined with extreme temperatures, the fumes caused motor-insulation failures every 4 to 6 months and were terrific "time killers." Beginning two years ago, the mill had its electrical shop start rewinding its motors with Fiberglas. 60 have been rewound with the result to date . . . no insulation failures . . . no wasteful downtime.

★ ★ ★

GETTING MOTORS back into service—and *keeping* them from killing precious production time—is an even more important job today than in peacetime. For, today, electrical equipment is the vital source of power for our war-production machine. When it isn't in service, it's a boost to the enemy.

Electrical men are devising methods and techniques to prevent such loss of production and valuable time. One tool they are using in ever-increasing volume is Fiberglas. As a component of electrical insulation, it is already helping keep peak production for the victory we are determined to win.

Engineers have skillfully used this material . . . which is unaffected by high temperatures . . . by corrosive chemicals, and moisture, as part of the insulation in electrical equipment that must operate in tough surroundings without frequent failures.

There is a Fiberglas product for every electrical insulation need . . . tapes, sleevings, tying cords, cloths—Fiberglas-backed mica combinations—Fiberglas-base laminated materials—saturated and varnished tubing and Fiberglas-insulated magnet wire.

Consult your electrical manufacturer or service repair shop about Fiberglas-insulated equipment. The next time a problem of tough surroundings comes up in your plant, remember how forward-looking engineers are solving similar problems in many industries. *Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

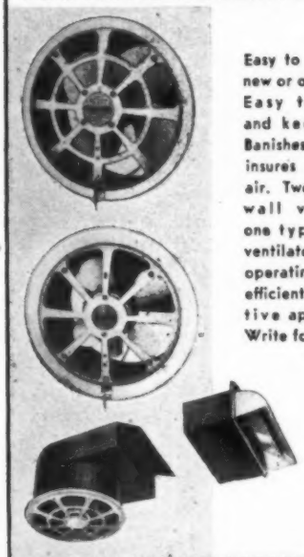
*T. M. Reg. U. S. Pat. Off.

OWENS-CORNING

FIBERGLAS

THE QUALITY NAME
VICTOR
IN-BILT
IN VENTILATION

FOR DEFENSE HOUSING
FOR HOME MODERNIZATION



Easy to install in new or old homes. Easy to clean and keep clean. Banishes odors, insures healthful air. Two styles of wall ventilators, one type ceiling ventilator. Quiet operating, highly efficient. Attractive appearance. Write for catalog.

VICTOR ELECTRIC PRODUCTS, INC.
Dept. IB-57, 2950 Robertson Ave., Cincinnati, O.

ILSCO
SOLDERLESS CONNECTORS

SOUND... *in construction*
SIMPLE . . . *in design*

Ilsco APPROVED SINGLE HOLE SOLDERING LUGS

Side formed. Wire size stamped on barrel of each lug. Smooth tongues . . . straight barrel ends. Clean! Made from maximum conductivity *seamless* copper tubing.

Please rush us sample and catalog.

MAIL THIS COUPON TODAY

FIRM NAME .....
NAME .....
ADDRESS .....

ILSCO COPPER TUBE AND PRODUCTS, INC.
4570 MADISON ROAD — CIN., O.

In the News

[FROM PAGE 148]

All lights normally visible from the sea shall be dimmed or shaded in such a manner that they will not be visible under any conditions at a distance of more than one mile from the shore. If they cannot be so dimmed or shaded, they shall be extinguished.

All exterior lights used for illumination or guidance of traffic (such as street lights) and all lights used for security measures or necessary outdoor protection, outdoor manufacture, storage or shipping of war materials (such as floodlights or artificial illumination in freight yards, docks or shipyards), shall be reduced in volume and number of wattage to a minimum consistent with their purpose and shaded so as to prevent their direct rays shining at an angle above the horizontal.

All other exterior lights used for illumination of open areas, such as parking lots, playgrounds, places of amusement or entertainment, sidewalk cafes, marquees, open-air gardens or terraces, etc., must be so shaded as to prevent their lights shining at an angle above the horizontal and the combined lighting of such areas may not exceed the average of one-quarter watt per square foot, and no individual light used for such purposes shall be in excess of 100 watts at the rated voltage.

All lights within display windows, shop windows, open lobbies and other places of business shall be so shaded by opaque material as to prevent their direct rays being visible from any point on the exterior of the window or opening and the total lighting of such display windows should not exceed the average of one-half watt per square foot of vertical window or opening. Where the lights of the interior of such shops, stores or other places of business are normally visible from the exterior thereof they shall be so shaded by opaque material as to prevent the direct rays being visible from any point outside the building. Lights reflected outward by mirrors or other polished surface are subject to these provisions. Where the display window or opening is not protected from the main portion of the store, shop or place of business by a protective backdrop or partition the wattage for lighting of the interior of such store, shop or place of business shall not exceed the average of one-quarter watt a square foot of floor space.

All other windows, openings and skylights that open either on the street or courtyard or roof shall be so screened or shaded as to prevent direct rays of light escaping therefrom. In lieu of complete screening or shading of such windows, the interior lights of the rooms concerned shall be individually shaded to prevent the shining or reflection of lights out of such windows.

All exterior advertising signs illuminated by floodlights, incandescent bulbs, neon, fluorescent or other lighting shall be extinguished.

COMING MEETINGS

New York State Association of Electrical Contractors and Dealers—The Sagamore, Bolton Landing on Lake George, N. Y., July 1–4.

National Electrical Contractors Association—Annual Convention, Bigwin Inn, Lake of Bays, Ontario, Aug. 31–Sept. 5.

International Association of Electrical Inspectors—Northwestern Section, Portland, Oregon Sept. 14–16. Southwestern Section. Fresno, Cal., Sept. 21–23. Western Section, Book-Cadillac Hotel, Detroit, Mich., Oct. 5–7. Eastern Section, Hotel Taft, New Haven, Conn., Oct. 12–14. Southern Section, Richmond, Va., Oct. 19–21.

Illuminating Engineering Society—Wartime Lighting Conference, St. Louis, Mo., Sept. 21–22.

National Electrical Manufacturers Association—Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y., Oct. 26–30.

BOOK REVIEWS

How to Read Electrical Blueprints

A comprehensive, detailed work on making and reading the drawings and diagrams of the electrical industry. The treatment is sufficiently elementary for the student yet thorough enough for the contractor and engineer. The opening chapter on blueprints, bell wiring diagrams and house wiring plans are fairly elementary. The following on large building plans, generators and motors, control circuits and power station diagrams are liberally illustrated and cover many advanced developments in wiring and apparatus.

An especially useful feature of the book are the pages of diagram symbols arranged with a picture of the apparatus adjoining each symbol. While primarily for the beginner, this arrangement will be found a convenient reference for the experienced electrical worker.

How to Read Electrical Blueprints by Gilbert M. Heine and Carl H. Dunlap, $3.00. American Technical Society, Chicago, Ill.

Industrial Electricity

The second edition of this well known and popular volume develops the principle of alternating currents and alternating current circuits and shows their application to industrial electrical apparatus. As the art has developed so far technically since the first edition of this work in 1925, the material contained in the new edition extends the theory and brings up to date the many practical illustrations.

While only the simplest mathematics is used, considerable emphasis is placed on the effect of inductance, capacitance and frequency in the flow of alternating cur-

rents. The theory has been extended to include such subjects as effective resistance of impedances, polygons of alternating vector quantities, energy and quadrature currents, kilovars and their effects on circuits.

In the chapter on measurements many very recent improvements are discussed including the cathode-ray oscillograph. The development of electron tubes and their applications is included in considerable detail in an entire chapter devoted to vacuum tubes.

Thirteen chapters cover the theory and application in a logical sequence, opening with "Alternating Currents and Voltage" and "Single-phase Alternating Currents." The author then takes up a.c. measurements and polyphase systems.

In the following chapters the major elements of a.c. apparatus are discussed; alternators, transformers, polyphase and single-phase motors, synchronous motors, rectifiers, transmission.

A liberal appendix provides mathematical data and tables of resistance, reactance and current capacity of conductors.

Industrial Electricity, Part II, by Chester L. Dawes, S. B., McGraw-Hill Book Co., New York, 480 pages, $2.75.

Priorities

SUBSTITUTE MATERIALS FOR LIGHT BULBS

The use of critical materials in the manufacture of electric light bulbs will be curtailed without curtailing the production of the light bulbs themselves, by an amendment to Limitation Order L-28 issued June 8.

This will be made possible through the use of substitutes that will not affect the efficiency of the light bulbs.

The base, formerly made of solid brass, will be made of steel, plated with brass. Lamp leads, formerly made of a 50-50 combination of nickel and copper, will be made of iron wire plated with nickel and copper. Filament supports formerly made of nickel and molybdenum, will be made of iron wire plated with nickel. The filament itself will continue to be made of tungsten, since no satisfactory substitute has been found. The plating process will require only about a tenth as much of the critical metals as was used before.

The substitution provisions of the order will go into effect July 1, 1942.

Not only will there not be a curtailment in the production of lamp bulbs, but the amendment permits greater production than in 1940.

The amendment also prohibits the manufacture of Christmas tree, advertising and decorative or display lights. The original order reduced such production by 50 percent.

RATING EXTENSIONS SIMPLIFIED

The use of preference ratings will be simplified and standardized by the terms of an amendment to Priorities Regulation No. 3, announced June 12 by the Director of Industry Operations.

Effective July 1, any preference rating, no matter how it has been assigned, may be applied or extended by a single form of certification, which states merely that the purchaser certified to the seller and to the War Production Board that he is entitled to use the preference ratings indicated on his purchase order.

Provisions of existing orders which require a purchaser to furnish his supplier with copies of preference rating orders or other special certifications are rescinded. This change does not, however, affect any provision of existing preference rating orders which limits the kinds of material which may be obtained by use of the assigned rating, or which requires specific information on purchase orders.

In addition to the standard certification, orders on which a preference rating is applied or extended after July 1 must also include the identification symbols required by Priorities Regulation No. 10, which established the Allocation Classification system.

The amended Regulation No. 3 restricts extension of preference ratings, in most cases, to material which will be delivered to, or physically incorporated in a product delivered to the person to whom the rating was originally assigned, or which will be used to replace in inventory materials so delivered, subject to definite limitations. A rating may not be extended to replace materials in inventory except to the extent necessary to restore the inventory to a practicable working minimum. No rating higher than A-1-b may be assigned to orders for replacement of materials in inventory, even though the order for which the materials were used may have carried a higher rating.

A "basketing" provision permits the simultaneous extension of ratings which have been assigned by different preference rating certificates or orders on a single purchase order.

LIMITATION ORDER L-114 CLARIFIED

Clarification of the interpretation of WPB safety equipment general limitation order L-114, dated May 5, was made by H. C. Mesch, Chief of the Safety and Technical Equipment Branch, Industrial Safety Equipment Section, WPB, on May 12, in a letter to a Chicago manufacturer of lineman's rubber protective equipment.

"Sure, Pop— I'll do it RIGHT NOW!"

In a few seconds, you can pull out a length of rigid conduit and insert Thin-Wall—at ANY outlet of ANY Kondu fitting.

And you can make either a Threadless or Threaded connection. (The bushings are interchangeable).

Every Kondu box is a Union

Without disturbing conduit, you can take out one box and put in another. (Have you ever seen any other fitting that will permit this?)

Self-locking . . . Kondu gives you a rigid, permanent, vibration-proof connection. Practically unbreakable . . . 100% re-usable. Quickest to install. *Write for the Kondu catalog.*

KONDU CORPORATION
Erie, Pa.

KONDU

THE WASHINGTON POST
S., Soviet Agree | Germans Claim

a 75-ton kick in the panzers!

Confidence is the strong and good cousin of that horrid word complacency. Most Americans are confident, few are complacent today. Confidence is our heritage, bequeathed to us by the pioneers, and nurtured by headlines of industrial marvels.

From the day when the Flatiron Building made news, to the colossal statistics of Grand Coulee, we have become firmly convinced that no task is too great for our vast construction industry.

That conviction is justified. A year before Pearl Harbor Sunday was anything more than a gleam in treacherous oriental eyes, our engineers and contractors were moving earth faster than it had ever been moved before . . . in preparation for projects which since have made our skyscrapers and giant bridges look like mere trial heats.

You know part of the story. We can't tell it all . . . complete aluminum plants built between Christmases . . . whole farms transfigured into bomber plants in less time than elapses between crops of corn . . . great shipyards in operation today on inlets that were frog ponds when the "Battle of Britain" was at its height.

How were these miracles of construction performed?

We can't call it genius. Germany, in particular, has many great engineering minds, yet the entire Axis is outstripped by our capacity to do big jobs fast.

We can't explain it by just calling it skill and experience. The new shipyards prove that . . . our skilled and experienced shipbuilders were absorbed by navy construction long ago. Yet we have met each new quota of cargo shipbuilding. Deep in our hearts we all know industry will meet whatever quota may be needed however impossible that may seem now.

▶ Some of these cargo ships and shipyards are being built by landlubbers . . . by men who knew nothing of the sea, but who were hell on reading blueprints and at designing and operating complicated machines.

There are several reasons why ordinary Americans become Supermen when faced by "fantastic" construction jobs.

▶ The first reason is the intrepid spirit of the management and men of American construction. With a slide rule in his hand, the most meek and stoop-shouldered of American engineers becomes a high adventurer. He is willing to gamble that the machines and men at his command can lick anything this side of the fourth dimension.

The second reason is motive power. The leaders of our construction industry have always had the guts to gamble the cost of big machines to do big jobs. Probably the rest of the world combined cannot match our array of power shovels, scrapers, bulldozers, compressors, welders, motors and engines for moving and moulding earth, water, steel and stone.

The third reason is men. A shovel weighing 75 tons needs a "75-ton mind" at the control levers . . . American labor takes to machinery as a co-ed takes to "swing."

The fourth reason is versatility. The construction industry is used to turning corners at high speed . . . to an organization that has built railroads, cathedrals, bridges, and movie palaces, making a munitions plant in a hurry just means more men, more machines and more night work, and more of that good American ingenuity.

In recognition of the miracle of war production—accomplished through the cooperation of American management and labor with the W. P. B. . . . . this advertisement is published by the McGraw-Hill Network of Industrial Communication.

P.S. The fifth reason is "mobilized information"

Through a distinctively American process, the Industrial Press, trial and error are reduced to a minimum. Information on successful new techniques flows freely from job to job.

If a factory in Kansas succeeds in laying the dust and stopping ruts in its parking lot, an engineer with the job of quick-surfacing a jungle airport reads how it was done in a construction magazine.

If a shipbuilder finds he can cut construction time in half by building hulls upside down, other shipbuilders learn about it from their technical magazines.

At McGraw-Hill alone 153 editors and 725 field-correspondents are constantly combing construction as well as industrial jobs to find new and faster methods. This "know-how" is then routed through industrial magazines to every industry where it can be helpful.

In addition to the editors, many industrial advertisers keep men in the construction field to watch the performance of their machines. Their reports are used in industrial advertising to show operators how to make machines do more work and last longer in these days of shortages of time and metal.

. . . Now this advertisement contains a moral and "commercial." The commercial objective is obvious. The moral is this:

▶ Let's remember how well government, management and labor are getting along together in the face of visible peril. When the war is all over, we need have no fear of the invisible perils of peace, if we tackle our jobs in the same cooperative spirit.

THE McGRAW-HILL NETWORK

More than 1,000,000 of the executives, designers and production men, who give America her world supremacy in technical "know-how," use the editorial and advertising content of the 23 McGraw-Hill publications as a means of exchanging ideas.

McGRAW-HILL BOOKS

Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

McGRAW-HILL PUBLISHING COMPANY, INC.
330 WEST 42nd STREET • NEW YORK

THE McGRAW-HILL NETWORK OF INDUSTRIAL PUBLICATIONS

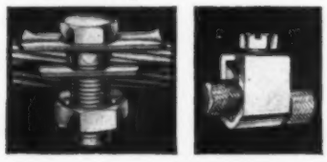
American Machinist
Aviation
Bus Transportation
Business Week
Chemical & Metallurgical Engineering
Coal Age
Construction Methods
Electrical Contracting
Electrical Merchandising
Electrical West
Electrical World
Electronics
Engineering & Mining Journal
E. & M. J. Metal and Mineral Markets
Engineering News-Record
Factory Management & Maintenance
Food Industries
Mill Supplies
Power
Product Engineering
Textile World
Transit Journal
Wholesaler's Salesman

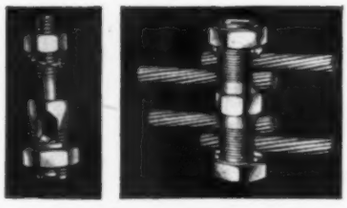
"All SIZES of SERVICE CONNECTORS—

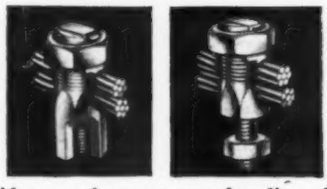
from No. 10 to 1,000,000

and All TYPES"

You can find exactly the service connector you need, in the Penn-Union Catalog: Yoke-and-Nut type, in a complete range of sizes . . . Service Entrance connectors . . . Service Post and Special connectors in wide variety.







Also . . . the most complete line of Tee Connectors, Cable Taps . . . Straight, Parallel, Elbow and Cross Connectors . . . Bus Supports, Clamps, Spacers . . . Grounding Clamps, Terminal Lugs . . . practically every good type.

Leading utilities, industrials, electrical manufacturers and contractors have found that "*Penn-Union*" *on a fitting is their best guarantee of Dependability*. Write for the Penn-Union Catalog.

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

In the News

[FROM PAGE 151]

Mr. Mesch pointed out that order L-114 covered only "personal" protective equipment, restricting the manufacture of these items, among other things, to gloves, overshoes, sleeves and blankets. He indicated that manufacture of other lineman's rubber protective equipment was governed by order M-15-B dated April 1. This latter order permits the manufacture of rubber gloves, line hose, insulator hoods, blankets, cable end test caps and separators, cable bandages, lineman's rubber sleeves and insulating stools.

WITH THE Manufacturers

G-E Promotions

C. F. Pittman, manager of the motor division of General Electric Company's industrial department, has been named

PITTMAN

HENRY

assistant to the manager of the industrial department.

W. H. Henry, who was manager of sales in the motor division, succeeds Mr. Pittman as manager of the division.

•

American Steel & Wire Elections

Robert E. Lewis has been elected treasurer and John G. Nelson has been elected secretary and assistant treasurer of the American Steel & Wire Co., subsidiary of the U. S. Steel Corp.

John N. Moylan was elected assistant treasurer with offices in Chicago; Robert Gordon assistant treasurer with offices in New York City and John B. Cavanagh assistant secretary with offices in Cleveland.

•

The Miller Company, Meriden, Conn., announces the election of S. R. Naysmith as vice-president in charge of engineering of the company.

Allis-Chalmers Manufacturing Co. has appointed William C. Johnson, manager of the Allis-Chalmers general sales organization. Mr. Johnson was formerly sales manager of the crushing and cement division. Until his election as president, Mr. Geist directed the general sales organization.

JOHNSON

•

Pittsburgh Reflector Company has named R. O. Williams Midwest sales manager. For the past nine years Mr. Williams has been manager of the Chicago branch office and he will continue to head this office, from which he will direct the sales activities in the Middle West District.

More Gossip

In Mayoralty Race

Dewey L. Johnson, superintendent of electrical affairs, City of Atlanta, Georgia has entered the political race for the mayoralty of Atlanta. Mr. Johnson is a member of IAEI and a member of the Electrical Committee NFPA, representing the United States Conference of Mayors.

New Electrical Ordinance

A city ordinance regulating the installation of electric wiring and also licensing electricians was recently passed at West Bend, Wis. The city engineer will enforce the ordinance.

A PARTING WORD, *in fact, several paragraphs, passed between Wally G. Campbell, Grand Rapids, Mich., and Andy Rogerson, Detroit after adjournment of recent Wolverine State Electrical Contractors meeting. Wally has the distinction of being the first president of the group.*

Ottawa Electricians Tagged

A new by-law passed at a special meeting of the Ottawa police commission requires Ottawa electricians to wear trade badges. This is in accordance with legislation passed in 1939, classifying electricians as either Master or journeymen electricians.

The former $30 contracting electrician licenses are no longer required. Now, master licenses are $10 and journeymen licenses, one dollar. Both classes must now wear special badges designating their trade status.

A. W. Discussion

A discussion of adequate wiring together with practical demonstrations and illustrations was recently presented by Robert W. Wilson, Kentucky Utilities Company, at Louisville, Ky. He was the guest speaker at a joint meeting of the Electrical Clearing House of Louisville and the Building Congress.

THREE MUSKETEERS from out Lansing way rake "labor only" contracts over the coals. Discussing the "pro's" and "con's" are (L to R) Wolverine contractors F. D. Perry, Lansing; R. E. Thayer, St. Johns; and Charles T. Reed, also of Lansing, Mich.

Geiss Heads A. W. Club

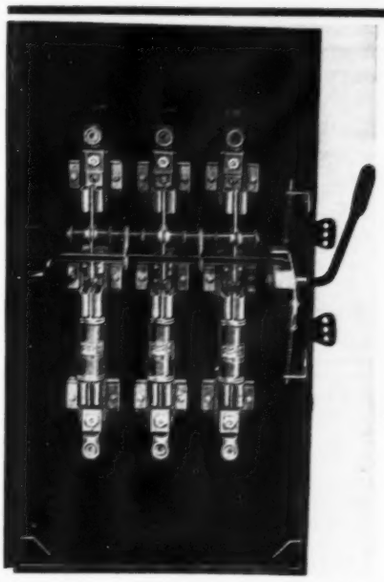
Fred Geiss, Kansas City, Mo., was recently elected president of the Adequate Wiring Club, sponsored by the local Chapter I.E.S.

Gastronomic Inspiration

Inspirations for increased shop efficiency often are born at Anderson's, Inc., Nashville, Tennessee motor shop, while pursuing the art of feeding the inner man.

Just such an idea emanated recently with the tantalizing aroma of country ham slowly baking under the shop's infra red lamps. Eugene Anderson was preparing a delicious ham for dinner and to get it "just so" he slowly rotated it so it would bake evenly.

Now he is applying the principle to the baking of coils and windings and, as a result, he is working on a rotating turntable to use with his infra red tunnel. Hams and motors must be properly baked to be at their best, Gene insists.

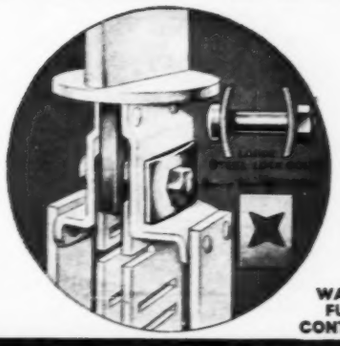


You Just Can't FRY EGGS Here

To End Overheating and Stop Costly Shutdowns . . .

Install

WARE HI-LAG FUSES



WARE FUSE CONTACTS

Time Lag, 2 to 5 Times Normal Current—Certified to comply—Federal Specification W F 803a—Type II.

Approved by Underwriters.

Keep Motors Humming

WARE BROTHERS

4410 W. LAKE ST., CHICAGO

HOW TO SAVE TIME DRILLING HOLES IN CONCRETE

Eliminate Long, Tiresome Chiseling

Save 75% of your skilled time when drilling through concrete, brick, tile, etc., by using Carboloy Masonry Drill-Points.

You will be amazed at the speed with which these drill-points penetrate building materials. Just slip one into your rotary drill (or hand brace) and save hours of slow, monotonous hand chiseling.

Stays sharp for long periods of use because it's tipped with Carboloy metal, approaching the diamond itself in hardness.

Send for leaflet.

Sold at leading supply houses

CARBOLOY COMPANY, INC.

11135 E. 8 Mile Blvd., Detroit, Mich.

FREE FOLDER

CARBOLOY

MASONRY DRILL-POINTS

ELECTRICAL SPECIALTIES

FOR HEAVY INDUSTRIAL SERVICE

RMC

One of the many various types of RUSGREEN Endulators. Also End Bells for use with steel or fibre conduit. D.C. service or non-ferrous metal.

RUSGREEN Bus Supports . . . made for indoor or outdoor service. All types and constructions.

For more than a quarter of a century, RUSGREEN has specialized in the manufacture of Standard and special electrical items for heavy industrial applications. All are built to the most exacting requirements . . . assurance that they'll do the job. Write for a complete selection of RUSGREEN bulletins.

ENDULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

★ ★ ★

RUSGREEN MFG. CO.

14260 Birwood Avenue • Detroit, Mich.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : BUSINESS : "OPPORTUNITIES" : EQUIPMENT : (Used or Resale)

UNDISPLAYED —RATES— DISPLAYED

15 CENTS A WORD. MINIMUM CHARGE $3.00
Positions Wanted (full or part time salaried employment only), ½ the above rates payable in advance.
Box Numbers—Care of publication New York, Chicago or San Francisco offices as 10 words.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.
Individual Spaces with border rules for prominent display of advertisements.

NEW ADVERTISEMENTS received by July 23 will appear in the August issue, subject to limitations of space available.

WE BUY AND SELL
MOTORS
TRANSFORMERS
MOTOR GEN. SETS
OIL SWITCHES
AIR CIRCUIT BREAKERS

ELECTRIC EQUIPMENT CO.
347 N. Clinton Ave., Rochester, N.Y. Tel: Main 252

POSITION VACANT

FOREMAN for electric motor repair shop, Troy, N. Y. area—opportunity for right man. State qualifications by letter. P-33, Electrical Contracting, 330 West 42nd St., New York City.

TRANSFORMERS
REBUILT—REPAIRED
Industrial Distribution Transformers
OIL OR AIR COOLED
Write
JOHNSON ELEC. MAINTENANCE CO.
1615 Clybourn Ave. Chicago, Ill.

MERCURY VAPOR LAMPS

500—400 Watt, aluminum reflectors, 110 or 220 v transformers.
500—1500 Watt Mazda Spot, aluminum reflector.

"BABY" MOTORS
Little Used—Perfect Condition

1000—1/75 hp Bodine ball bearing motors, 3 ph 208 v ac 1800 rpm reduction gear 96 to 1.
300—1/25 hp Westinghouse 110 v universal 2-speed reduction gear 25 and 150 rpm.

EASTERN SALVAGE COMPANY
208 Lafayette St. New York City

ELECTRICAL
DESIGNERS
AND
DRAFTSMEN

for power applications and distribution system design on steel plants and power plants.

This is
IMPORTANT WAR WORK

working 56 hours 3 weeks per month and 44 hours one week per month with time and one-half for work in excess of 40 hours per week.

In replying please give complete details including compensation desired.

ARTHUR G. McKEE & COMPANY
2300 Chester Avenue
Cleveland, Ohio

Applicants now employed on war work, will not be considered, unless they obtain written release from present employer.

NATIONAL
CLASSIFIED
ADVERTISING . . . The SEARCHLIGHT SECTIONS of these McGRAW-HILL PUBLICATIONS

for bringing business needs or "opportunities" to the attention of men in administrative, executive, management, sales and technical engineering and operating capacities in the industries served by McGraw-Hill publications.

Departmental Staff
McGraw-Hill Publishing Co., Inc.
330 W. 42nd St., New York City

American Machinist
Aviation
Bus Transportation
Business Week
Chemical & Met. Engineering
Coal Age
Construction Methods
Electrical Contracting
Electrical Merchandising
Electrical World
Electronics
Engineering News-Record
Engineering & Mining Journal
E & M J Market
Factory Management & Maint.
Food Industries
Power
Product Engineering
Textile World
Transit Journal

More Gossip

Condo Moves

Expanded business activities necessitated the acquisition of larger quarters for the Condo Electric Company, Chicago electrical contractors.

On May 1 the company moved into its own building at 1071 W. Fry Street, Chicago. Now, with more space, added personnel and a complete stock of materials for wiring maintenance and repair, they offer an expanded service in the electrical construction and repair fields. The former company address was 123 N. Jefferson St., Chicago.

PRIDE OF CHATTANOOGA'S electrical contractor group is Mrs. W. H. Ashmore, only woman electrical contractor in the city. Here she is discussing conditions with fellow contractors V. Clark (left) and C. E. Cofer, both of Chattanooga.

No Radio Interference

A city ordinance regulating the use of devices, appliances, or apparatus interfering with radio reception, was recently passed in Neenah, Wis. A similar ordinance was passed in Peoria, Ill., regulating equipment and appliances that interfere with radio transmission, reception and communication.

Oshkosh, Wis., has now added the duties of radio inspector to the position of electrical inspector.

Greenland On Canadian Code Committee

J. E. Greenland, president, Ontario Electrical Construction Co., Ltd., Toronto, has been appointed to represent the Ontario committee on the Canadian Electrical Code, Part I. He succeeds Col. James Harris, who was forced to retire in this capacity because of the pressure of war work.

Mr. Greenland also represented the Ontario Electrical Contractors' Association at a recent meeting of the Canadian Engineering Standards Association, in Montreal.

Shaft Build-up By Metallizing

[FROM PAGE 26]

ridges of the grooves, roughening, turning up barbs and slightly peening over the groove ridges to provide a bond strength almost equal to that of the sprayed metal itself. This method is now standard shop practice.

2. Metal Spraying

To spray shafts, the work is rotated in a lathe. The metal spray gun is mounted in the lathe tool post with the gun nozzle at least 6-in. from the work. The carriage feed is set to traverse the gun back and forth in front of the work until sufficient metal has been sprayed on to allow for machining or grinding the built-up portion down to regular shaft size.

3. Machining or Grinding

The finish machining or grinding, as the case may be, completes the build-up process. After spraying is completed, the sprayed "hump" is machined or ground down to the shaft size.

What It Costs

To give an idea of metallizing costs, three estimates for different size shafts are presented. They are based on a labor cost of $1.00 per hour; average gas cost; compressed air allowance; set-up, preparation, and spraying and finishing time. All are based on applying ⅛-in. of No. 10 carbon steel on the diameter, with allowances for end loss and excess material for finishing. No overhead and profit are included.

COMPARATIVE COSTS

Dia. of Shaft	Bearing Section	Pounds of Metal Req.	Preparation Time—Min.
1½-in.	2-in.	0.75	30
2½-in.	4-in.	1.75	45
4-in.	6-in.	2.60	60

Dia. of Shaft	Spraying Time—Min.	Finishing Time—Min.	Total Cost Mat.& Labor
1½-in.	5	21	$1.12
2½-in.	13	51	$2.25
4-in.	20	100	$3.75

As applied to the motor shop, metal spraying can be used to build-up worn shafts to fit standard bearings, and in all cases where worn metal parts could be rebuilt. On exceptionally large jobs this could be done in the field. It also provides a means of offering emergency service through the reclamation of used machine parts.

Under present wartime conditions, this method expedites speedy repairs.

WHERE TO BUY

Equipment, Materials and Supplies for Electrical Construction—Maintenance—Repairs

DRILLS CONCRETE—METAL—WOOD

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Saves time and money installing expansion anchors. Drills concrete to 1⅛" dia.; metal to ⅜". Two tools in one. Easy to maintain. Universal motor. Write for folder.

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Only TEST-O-LITE, original Neon tester, has exclusive patented safety features. Far superior to clumsy test bulb. Fountain pen size with pocket clip. Useful in homes also.

List $1.50 at leading jobbers.

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Handiest tool in kit. Pulls all fuses ¼" to 13/16" dia. Hard horn fibre, 3⅛" long. Big help with vice-like Beryllium copper clips or crowded panels. 15¢ post paid anywhere in U.S.A.

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A Good Habit

This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in the electrical construction, maintenance and repair. Make a habit of checking this page each issue.

ALLEN SODERING PASTE

Fast working—Corrosion-free. Assures secure electrical and mechanical joints. Triples strength of the solder. National Underwriters Laboratory approved listing.

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What about your future? Who is safe today? Surely not the man who is contented to stand still! Know your job thoroughly—prepare yourself for jobs ahead. To do just this thousands of men have used

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Home Address.....

City and State.....

Position .....

Name of Company.....E.C. 7-42

More Gossip

Edenfield Moves

Edenfield Electric Co., enterprising electrical contractors of Nashville, Tenn., have recently moved into their new and modern one-story building at 303 Eighth Ave., S., Nashville. The old address was at 517 Eighth Ave., S.

The new and larger quarters were necessary due to the extensive amount of defense plant work the firm is doing throughout the country. Ray Edenfield is kept busy commuting by plane between Nashville, Meriden, Miss., and Spokane, Wash., and other sections of the country where he has large jobs in the works.

NO SHOP TALK was the rule as these boys got together for some good old fashioned yarns after NISA convention sessions at Cincinnati. These Boston, Mass., delegates are (L. to R.) Herbert Jacobson, Electric Maintenance Co.; A. Werby, A. Werby & Co.; and Harry G. Bedig, Electric Maintenance Co.

Meet Mr. Nickles

R. J. Nickles, electrical contractor of Madison, Wis., recently published a very fine advertisement which attracted much attention because of its simplicity.

A picture of Mr. Nickles appeared in the ad, with this accompanying copy, "MEET MR. NICKLES. . . . We are just old fashioned enough to believe that the type of electrical work we have been doing for the past 36 years is the best advertising after all. We rarely lose a customer who really appreciates good electrical work at a fair price. High grade materials and skilled craftsmen make for a combination of excellence."

Canadian Contractors Make Code Suggestions

Steps are now being taken to revamp the Canadian Electrical Code to permit material substitutions for strategic items.

Electrical contractors are being requested to offer suggestions for the preparation of the Wartime Code. The contractors are the ones directly faced with critical material shortages, know the electrical and field construction problems that arise, and hence will be in a position to contribute helpful ideas.

Preventive Maintenance

[FROM PAGE 23]

of one unit will not necessarily cause a complete shut down of the affected area. All transformer stations are equipped with primary disconnect fuses and heavy duty secondary switches so that any particular station may be isolated.

Inspections Recorded

Questionable apparatus may be reported to the works engineering department in one of many different manners. The usual way is to have the defect reported to the division affected and they, in turn, notify the engineering department on a regular form. This particular form, known as the electrical inspection report, covers practically every type of electrical apparatus in use. When this report is received by the engineering department, the apparatus under question is immediately examined by the electrical inspector who, in conjunction with the works electrical engineer, makes the proper recommendations to the superintendent of the division. The engineering department then allows a reasonable time for the necessary repairs to be made.

Records of tests and inspections necessarily may become rather voluminous. Nevertheless, they serve well in showing the condition of the equipment as it is checked from time to time. On transformers, for example, a record showing a continuous abnormal rise in the temperature of a transformer station above previous records calls for investigation. A check with a recording wattmeter or ammeter may give a picture of a station becoming overloaded due to increased demands placed on it. Thus, the check gives the engineering department sufficient time to make arrangements to shift some of the load to another transformer station. If this is not possible, arrangements are made to install another transformer station in parallel.

Routine inspection is probably the most effective means of preventing electrical equipment from causing serious power outages and work stoppages. Usually, and particularly at the present time when all plants are seriously overloaded with manufacturing of all classifications, little thought is given to the importance of looking after electrical equipment. The equipment might be run until it falls apart. Then the replacement problem becomes serious. A simple routine check at stated intervals is worth the expense involved and is tremendously offset by the savings in new equipment and power outages to other apparatus.

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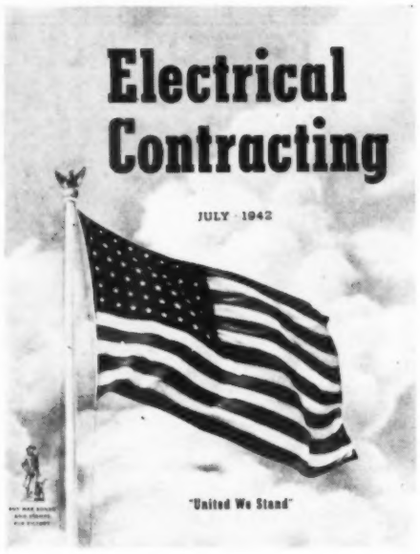
★ **These companies have included Briefalogs, containing additional buying information on their products, in the 1942 Edition of the Electrical Buyers' Reference.**



OUR FLAG

Out in front of your house and ours this Fourth we are flying our Flag. Down at the office and out on the job more Flags will be seen than ever before. In the seven months since Pearl Harbor we have learned much of what this proud emblem means. Its display should be a respectful ceremony befitting a symbol of our unity, our heritage and our national honor.

There are certain usages and regulations about the display of the Flag which should always be observed. They insure proper and uniform respect in the variety of circumstances when the Flag is displayed. In these days we should all know these rules and observe them carefully.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

SALUTING THE FLAG

1. Civilians, as well as soldiers, should salute when the flag is being raised or lowered or when it passes in a parade.

2. A man not in uniform salutes by removing his hat with his right hand and placing it over his heart, while standing upright with heels together.

3. A woman in civilian attire places her right hand over her heart, while standing upright.

4. Whenever the Star Spangled Banner is played, a civilian stands upright and faces the music, with right hand over heart, except when the flag is being lowered at sunset, on which occasion he faces the flag and salutes as described above. The salute is held until the last note of the anthem is played.

DISPLAYING THE FLAG

1. The Flag should be displayed from sunrise to sunset. It should be hoisted briskly, but should be lowered slowly and ceremoniously. The Flag should be displayed on all National and State holidays and on historic and special occasions.

2. When carried in a procession with other flag or flags, the Flag of the United States of America should be either on the marching right—i.e., the Flag's own right—or when there is a line of other flags, the Flag of the United States of America may be in front of the center of that line.

3. When displayed with another flag against a wall from crossed staffs, the Flag of the United States of America should be on the right, the Flag's own right (the observer's left), and its staff should be in front of the staff of the other flag.

4. When a number of flags of States or cities or pennants of societies are grouped and displayed from staffs with the Flag of the United States of America, the latter should be at the center or at the highest point of the group.

5. When flags of States or cities or pennants of societies are flown on the same halyard with the Flag of the United States of America, the latter should always be at the peak. When flown from adjacent masts, the Flag of the United States of America should be hoisted first and lowered last. No such flag or pennant flown in the former position should be placed above or in the latter position to the right of the Flag of the United States of America; i.e., to the observer's left.

6. When flags of two or more nations are displayed, they should be flown from separate masts at the same height and the flags should be of approximately equal size. International usage forbids the display of the flag of one nation above that of another nation in time of peace.

7. When the Flag is displayed from a staff projecting horizontally or at an angle from the window sill, balcony or front of building, the union of the Flag should go clear to the peak unless the Flag is at half-mast. (When the Flag is suspended over a sidewalk from a rope extending from a house to a pole at the edge of the sidewalk, the Flag should be hoisted out from the building toward the pole, union first.)

8. When the Flag is displayed in a manner other than by being flown from a mast, it should be displayed flat, whether indoors or out. When displayed either horizontally or vertically against a wall, the union should be uppermost and to the Flag's own right; i.e., to the observer's left. When displayed in a window it should be displayed the same way; that is, with the union or blue field to the left of the observer in the street. When festoons, rosettes, or drapings are desired, bunting of blue, white, and red should be used, but never the Flag.

9. When displayed over the middle of the street, the Flag should be suspended vertically with the union to the north in an east-and-west street or to the east in a north-and-south street.

10. When used on a speaker's platform, the Flag, if displayed flat, should be displayed above and behind the speaker. If flown from a staff it should be in the position of honor, at the speaker's right. It should never be used to cover the speaker's desk nor to drape over the front of the platform, but bunting may be used for this purpose, if desired.

11. When used in connection with the unveiling of a statue or monument, the Flag should form a distinctive feature during the ceremony, but the Flag itself should never be used as the covering for the statue.

12. When flown at half-mast, the Flag should be hoisted to the peak for an instant and then lowered to the half-mast position; but before lowering the Flag for the day it should be raised again to the peak. By half-mast is meant hauling down the Flag to one-half the distance between the top and bottom of the mast. (On a pole, the Flag flies its own width below the peak.)

13. Flags flown from fixed masts are placed at half-mast to indicate mourning. When the Flag is displayed on a small staff, as when carried in a parade, mourning is indicated by attaching two streamers of black crepe to the spear-head, allowing the streamers to fall naturally. Crepe is used on the flagstaff only by order of the President.

14. When used to cover a casket, the Flag should be placed so that the union is at the head and over the left shoulder. The Flag should not be lowered into the grave nor allowed to touch the ground. The casket should be carried foot first.

15. When the Flag is displayed in the body of the church, it should be from a staff placed in the position of honor at the congregation's right as they face the clergyman. The service flag, the State flag, or other flag should be at the left of the congregation. If in the chancel or on the platform the Flag of the United States of America should be placed at the clergyman's right as he faces the congregation and the other flags at his left.

16. When the Flag is in such a condition that it is no longer a fitting emblem for display, it should not be cast aside or used in any way that might be viewed as disrespectful to the national colors, but should be destroyed as a whole privately, preferably by burning or by some other method in harmony with the reverence and respect we owe to the emblem representing our country.

There'll be 400 of them!

A SQUARE D MULTI-BREAKER IN EVERY ONE

Proving again that Multi-breakers are a "Natural" for Housing Projects

One hundred and thirty homes already built—two hundred and seventy more to follow—in this "Central Manor" housing project in the southwest Chicago area. All of them are in the $6,000 price class and the fact that they're "selling on sight" speaks for the quality and value which is built into every one.

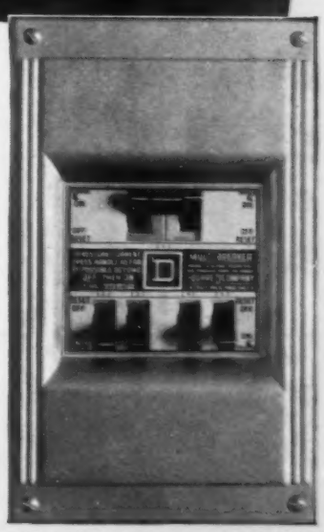
The Finitzo Brothers have a background of twenty years' successful building. They put into their houses those things which "prove out" in terms of customer convenience and sales appeal. It was on that basis that the Ideal Electric Company, electrical contractor, sold them on Multi-breaker installations instead of ordinary switch and fuse equipment.

The Multi-breaker eliminates fuses completely. When a short circuit or dangerous overload occurs, the circuit is cut off automatically. A simple movement of the shock-proof circuit breaker lever restores the current when the danger no longer exists. There are no delays—nothing to replace. The Multi-breaker's cost is about the same as for the fusible equipment it replaces—often actually less.

Scores of contractors know, from actual experience, that the Multi-breaker leads to more and better wiring jobs.

CALL IN A SQUARE D MAN

Contractor R. J. Kay of the Ideal Electric Company, Chicago, sells Square D Multi-breaker installations regularly.



Here is the type of Multi-breaker used in the "Miracle" homes. It provides for a range circuit and four lighting circuits.

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

KOLLSMAN INSTRUMENT DIVISION, ELMHURST, NEW YORK

IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

Ray Schweissinger (right) and Ewald Rollenhagen, salesmen for the Fitzpatrick Electric Co., G-E distributor, Muskegon, Mich., are discussing good ways for serving their war production customers and for helping in the rapid conversion and expansion of factories, foundries, etc., for war jobs.

Wherever You Are See Your G-E WIRING MATERIALS DISTRIBUTOR For War Construction Wiring Supplies

There is a G-E Wiring Materials Distributor near you—one of the many located at key points all over the country. You'll find this distributor eager to serve you and to co-operate in aiding the war effort. Suitable wiring materials for all types of war projects are available.

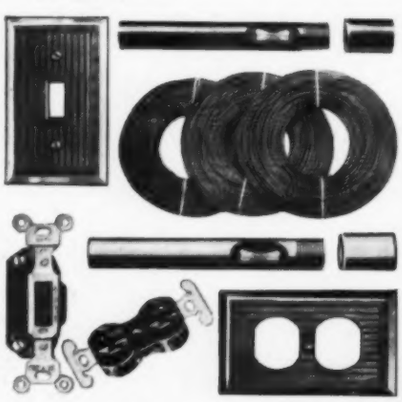
What is more, the materials handled by your General Electric Wiring Materials Distributor have high quality. They are all made by one manufacturer. The conduits, boxes and fittings, wires and cables and wiring devices can be depended upon for ease of installation and customer satisfaction.

Ask a representative of your General Electric Wiring Materials Distributor to call. He'll be happy to help you in many ways: with advice on priority problems . . . material selection . . . installation problems . . . efficient delivery of materials.

Frank G. Klein, city salesman, General Electric Supply Corp., St. Paul, Minn., with a service record of 37 years, uses experience to help customers. Mr. Klein was with the North Western Electric Equipment Co., when the General Electric Supply Corporation took it over in 1916.

G-E WIRING MATERIALS INFORMATION

See your G-E Wiring Materials Distributor for full information on G-E conduit, wire and cable and wiring devices to meet your special needs. Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.



Thirty-one G. E. Wiring Materials District Representatives help distributors serve customers. This is H. D. "Bud" Post, who covers most of Pennsylvania.

C. J. Miller (left) and H. W. Miller (second) visit new offices and display room of the General Electric Supply Corporation, Omaha, Nebraska. E. R. Jorgensen (third), service manager, and F. K. Rossiter (fourth), salesman, are showing them the new surface wiring devices for temporary buildings.

GENERAL ELECTRIC